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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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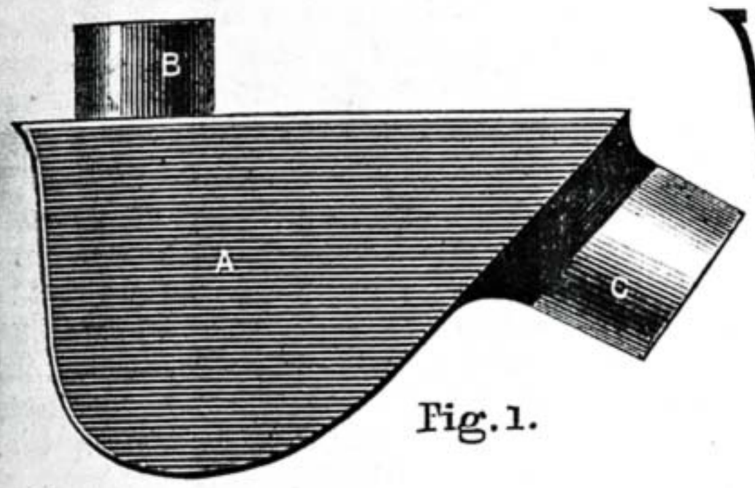
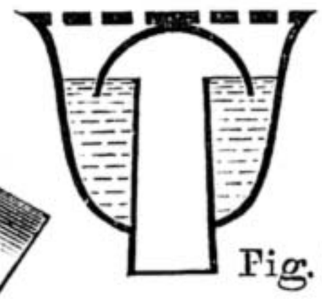


Fig. 1.



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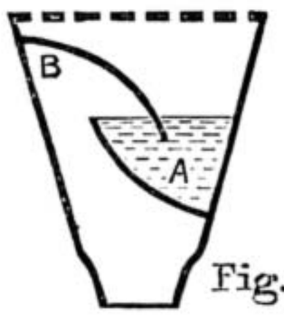

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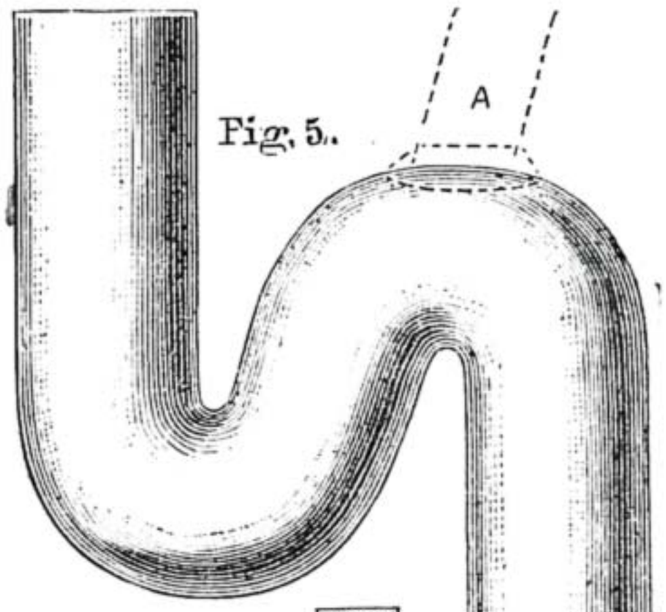

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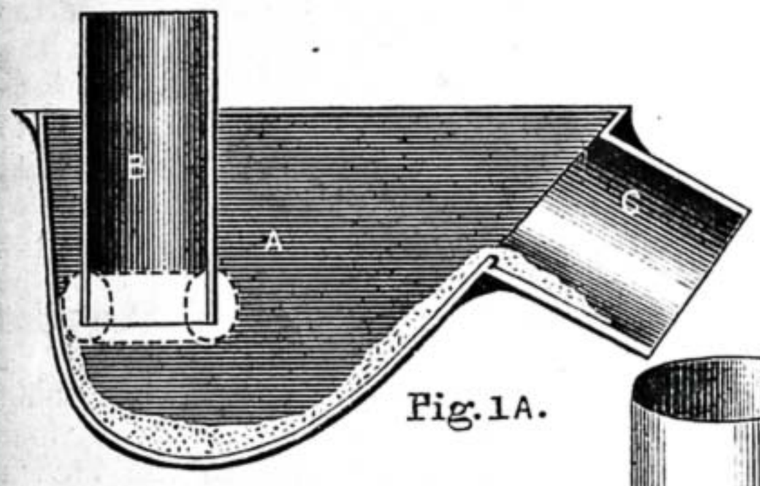
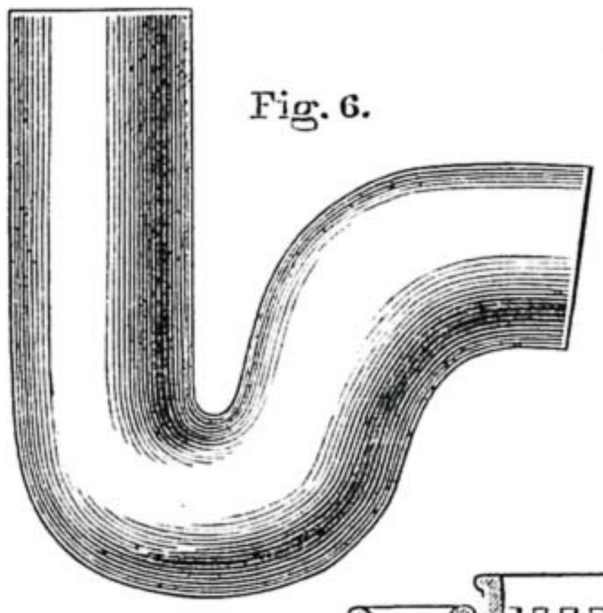


Fig. 1A.



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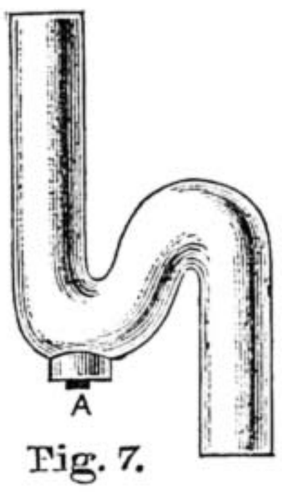

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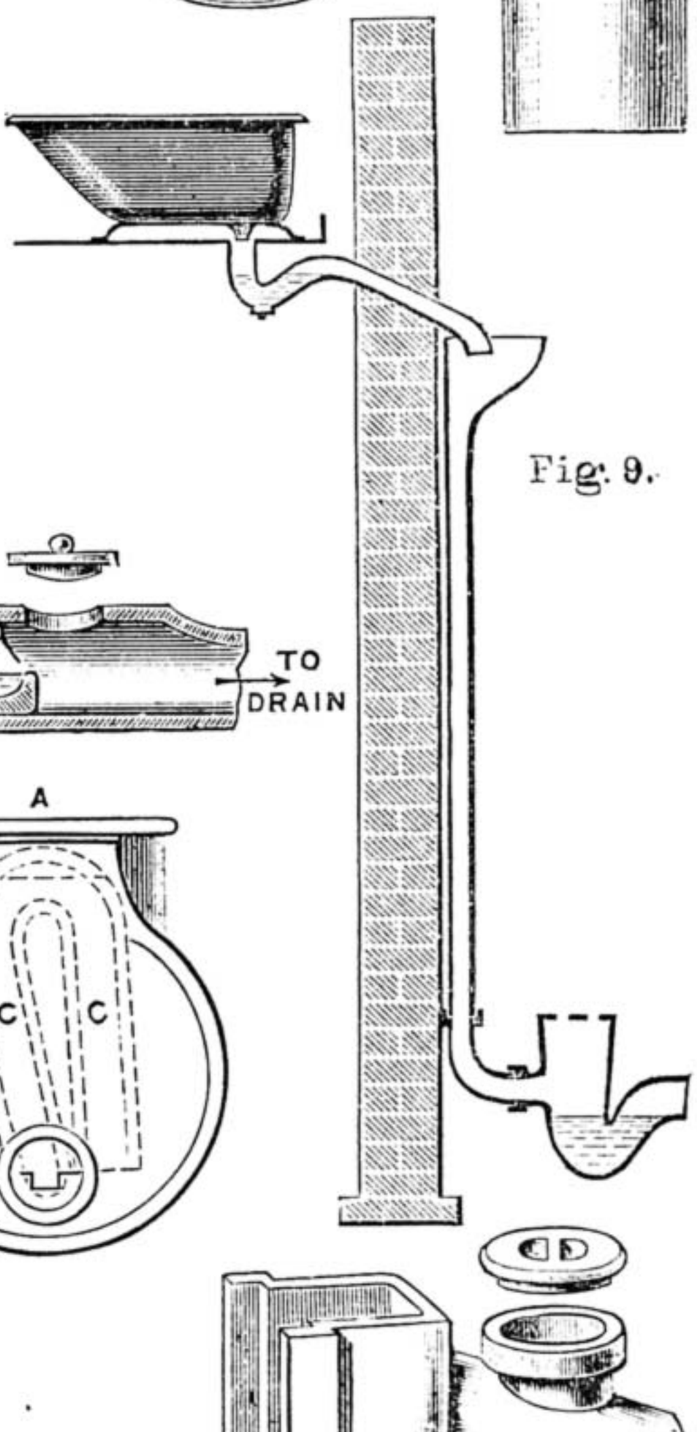

Fig. 9.

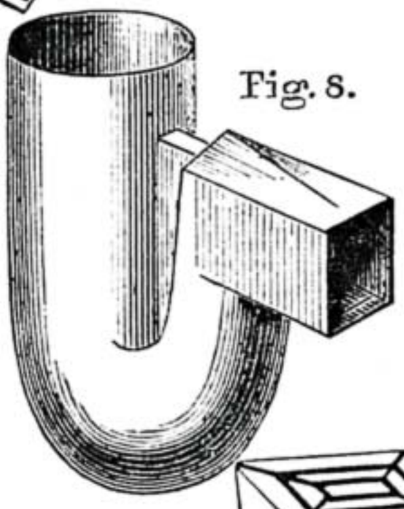

Fig. 8.

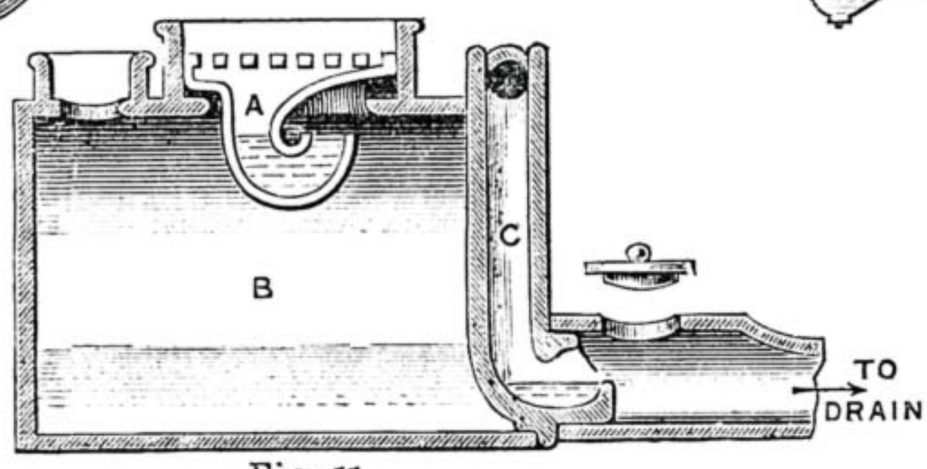

Fig. 11.

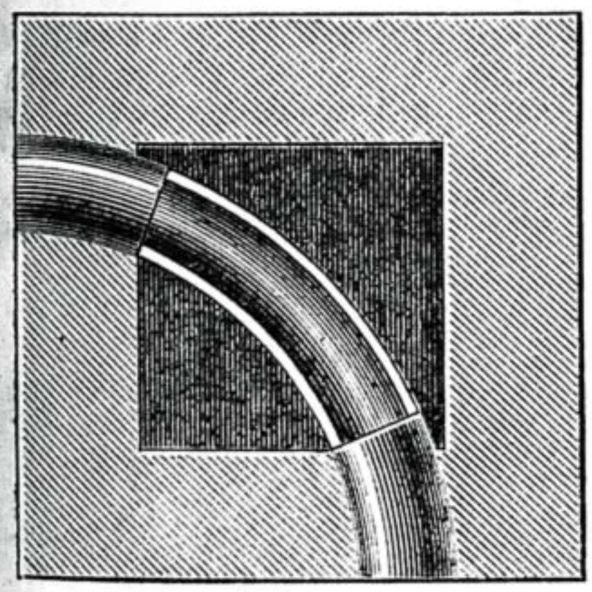

Fig. 10.

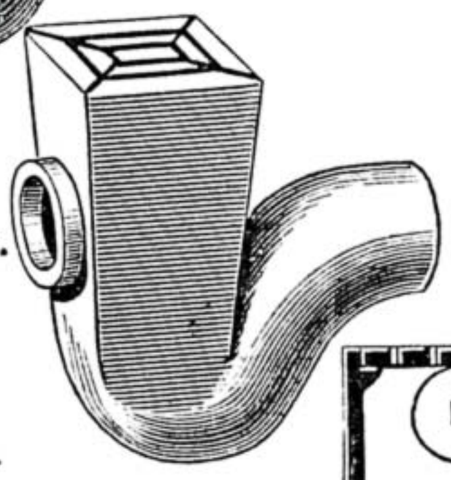

Fig. 12.

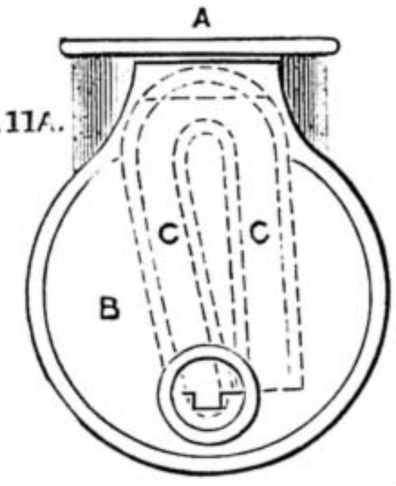

Fig. 11A.

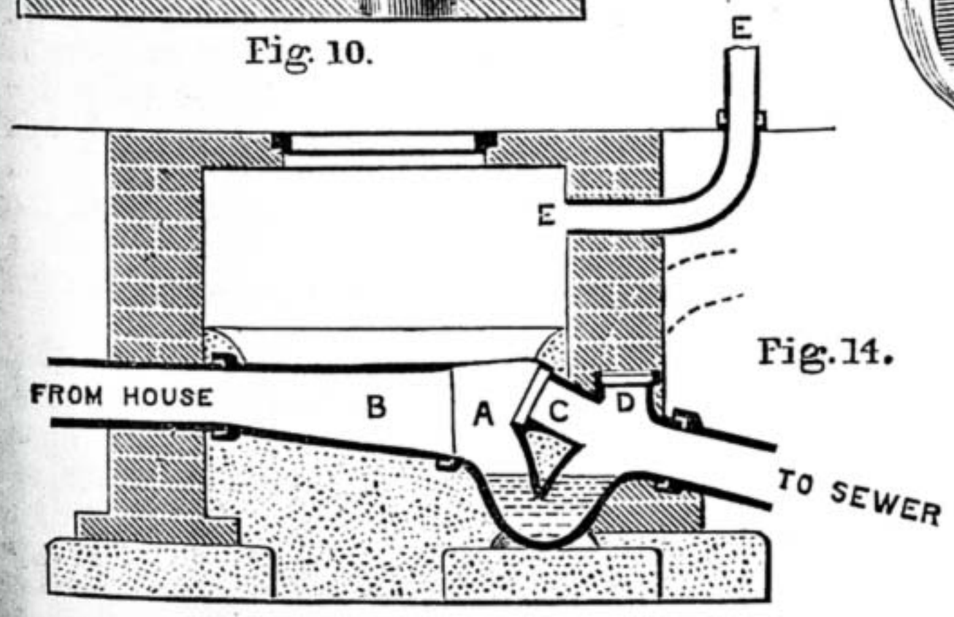

Fig. 14.

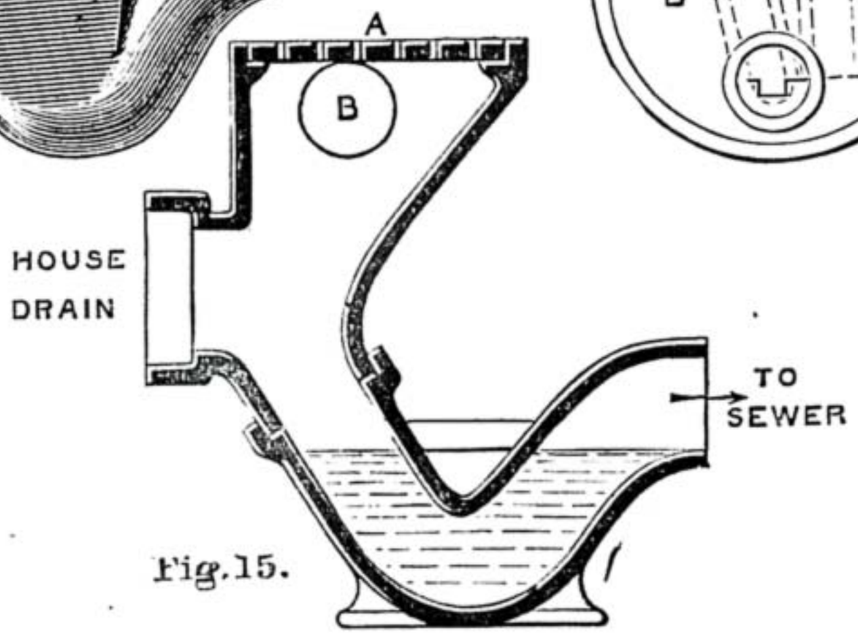

Fig. 15.

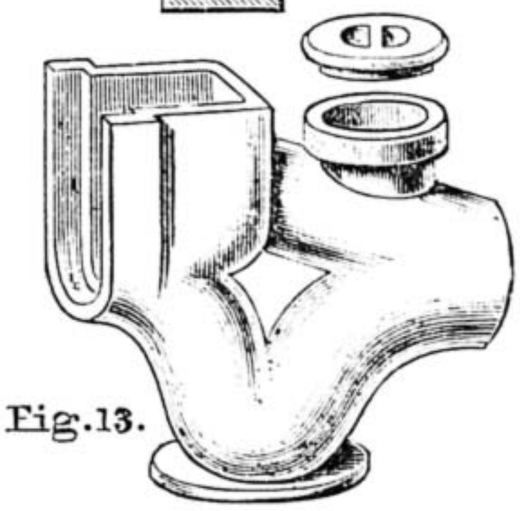

Fig. 13.

Fig. 1.—Lead D Trap. Fig. 1 A.—Section of ditto. Fig. 2.—Bell Trap: section. Fig. 3.—Iron Box Trap: section. Fig. 4.—Iron Box Trap, sometimes called D Trap: section. Fig. 5.—Lead S Trap, showing Place for connecting Air-Pipe. Fig. 6.—Lead P Trap. Fig. 7.—Small Lead S Trap, with Cleansing Screw A. Fig. 8.—Hellyer's Anti-D Trap with Square Outgo. Fig. 9.—Diagram showing Manner of conducting Wash from Bath into Drain through Open Gully-Traps. Fig. 10.—Open Channel Bend fixed in Brick Manhole for Inspection. Fig. 11.—Field's Flushing Tank for Drains. Fig. 11 A.—Side Section of ditto. Fig. 12.—Gully-Trap, with Inlet at Back. Fig. 13.—Hellyer's "Drain Sentinel." Fig. 14.—Disconnecting Air Chamber with Hellyer's "Drain Sentinel" Trap and Channel leading to it—A, Trap; B, Channel; C, Inspection Arm; D, Arm for Air Inlet; E, Air-Pipe to Manhole. Fig. 15.—Section of Hellyer's Ventilating Drain Syphon—A, Grating and Inlet for Air; B, Inlet for Air when A is covered.

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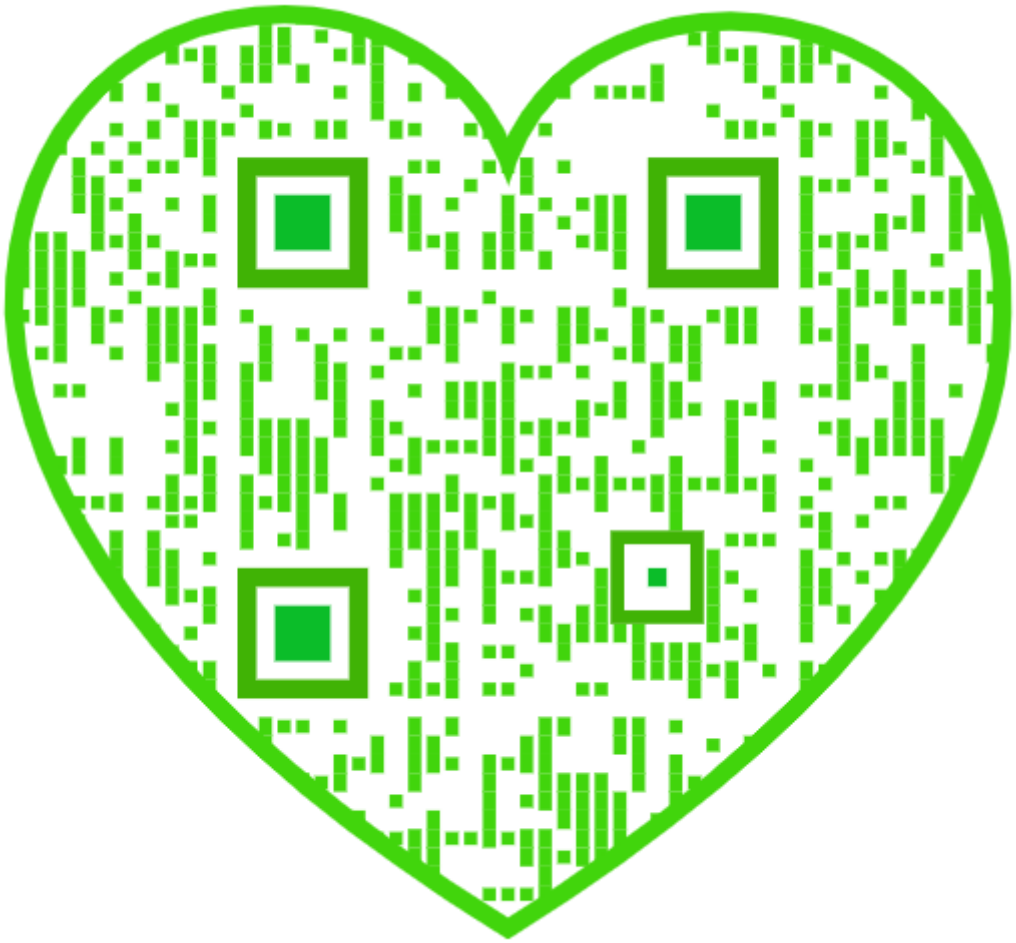

TRAPS AND DRAIN SYPHONS.

BY W. R.

WHAT an exceedingly cautious man is the average British householder!

With what care he locks and bolts his doors at night, sets electric and all sorts of alarums, lets loose his dog, and takes every precaution to keep away that ingenious fellow, the enterprising burglar!

He sleeps in peace, and fancies he is safe, but how often do we find that an enemy worse than any burglar is stealing up from the underground regions through a pipe but a few inches in diameter, and finding its way into his very bedroom, robs him of that which is far more precious than his plate—his health!

He spends pounds freely to keep out the burglar, but if he has a plumber's bill of a few shillings for repairs to his water-closet or some such apparatus to keep off this enemy—sewer-gas—he storms and fumes under the conviction that he is being taken advantage of.

Every householder should know the state of all the sanitary arrangements in his house, so that he might understand the grave necessity for keeping them constantly cleansed and in good order, and also know what should be done when repairs are necessary. The most particular part of any sanitary fitting is its trap, which bears to it the same relation as the lock does to the door. As we ofttimes find a door guarded by a very poor lock, so do we very often discover a water-closet, a sink, a lavatory, or some such fitting, provided with a very ineffectual trap, and sometimes without one at all.

Now it should be laid down as a law of the "Medes and Persians," that every sanitary fitting should be disconnected from the drain by a proper and effectual trap.

The material of which a trap is made deserves important consideration. It should be either lead or earthenware; iron is sometimes used, but cannot be recommended even if coated as explained in a former paper or enamelled, for as it is holding water constantly and sometimes fæcal matter of a very corrosive nature, it is liable to rust and become rough and dirty.

For indoor work, lead traps are decidedly the best, but they need to be well ventilated, for I have seen a lead trap eaten in small holes like a sieve by the foul gases which had accumulated in the soil-pipe, in which no means of ventilation had been provided. For it must be remembered that effete organic matter begins to be decomposed immediately on passing into the drain, and gives off that foul and dangerous gas which we call sewer-gas.

For outdoor work, earthenware is best suited, as being fixed underground and of a non-corrosive nature, it is not liable to damage from a chance blow without, or from the foul air and matter within.

Sometimes, as explained in p. 516, we have to fix earthenware traps attached to w.c.'s within the house, and in such positions when fixed as explained therein, they give every satisfaction; but for traps immediately under housemaids' sinks, lavatory basins, baths, etc., lead should always be used.

One of the oldest traps now in use is the D trap, shown at Figs. 1, 1A. It was formerly extensively used for water-closets, and is very often found in combination with that abomination the pan-closet, though it is sometimes made in smaller sizes for sinks, lavatories, etc.

It consists of a lead body or box, A, with a dip or inlet-pipe, B, and an outlet C. The various parts are soldered together. As before stated, this trap is one of the oldest, and is at the same time one of the worst, traps in use, for despite the crusade against them, hundreds are still in use in various towns.

The body A soon becomes foul, for one flush from the closet never washes out all the excrement which has been deposited into it, and in a short time, if frequently used, it becomes a veritable cesspool.

The dip-pipe B is often fixed some distance from the band, as may be seen in the section Fig. 1, thus leaving a space for soil and any foul matter to collect, and it is generally either too short or too long; if the former, the trap soon ceases to act as one if there is the least syphonage; and if the latter, the soil and paper are more than ever impeded from leaving the trap.

The dotted line in the section shows where the foul matter chiefly settles and becomes hard and cement-like.

The air-pipe—if any—which is connected to this trap is usually either ¾ in. or 1 in. in diameter, and has so many turns and bends in it, that it is scarcely better than nothing at all.

And here, in passing, I may say that no soil air-pipe should be fixed less than 2 in. in diameter, for the plumber should know that the obstruction to the passage of the air caused by the friction, due to the velocity with which the air passes through a pipe, increases as the square of the velocity divided by the diameter of the pipe; thus the obstruction offered in a 1-in. pipe to a given volume of air passing through a given length in a given time is thirty-two times as great as in a 2-in. pipe.

By far the best plan is to carry a pipe the full bore of the soil-pipe up to the roof, and let it stand a little above the ridge, so as to keep all foul air escaping therefrom away from the windows.

Another trap whose sins are many is shown in section at Fig. 2, and is styled the "bell trap," on account of the bell which is fastened to the grating and which forms the "dip" or water-seal. It is used for sinks, and also for surface-water. The space all round the stand-pipe soon becomes filled with dirt, as the passage of the water through the trap is so sluggish that it cannot keep itself clean, and the inevitable result is the pulling up of the grating and knocking off the bell, when the water runs off merrily, and leaves a free vent for anything in the shape of bad air or gases which should chance that way.

Some makers have tried to improve this trap in many ways, but under whatever disguise they offer it to you, have nothing at all to do with it, for it soon ceases to be a trap and becomes a snare, while there are plenty of good traps to be had equally as cheap.

Figs. 3 and 4 show sections of traps which are as kings to the bell trap, but yet are far from perfect. They are both made on the same principle; one, however, empties itself at the side, while the other passes the water through the bottom. They are usually made of iron and are used for stone sinks, or on the ground-level for surface-water. They both suffer from one great defect, they are not self-cleansing, for in the angles marked A and B, dirt, soap, and slime will collect, impeding the passage of the water, and finally stopping it altogether, when the trap has to be lifted out and cleaned, and as it is very often merely dropped into its place and not cemented as it should be, this can easily be done, and to prevent a recurrence of the nuisance the trap is flung on one side, and a free exit for drain air is the consequence.

Since Messrs. Beard and Dent first introduced their patent cast lead traps, great strides have been made in this department of sanitary science. Figs. 5 and 6 show specimens of their S and P traps: they are made in any size from 1¼ in. to 4 in., and possess many advantages over the old D trap. They have no places in which filth can accumulate, they are smooth, without any joints or seams, and are very easily flushed. The "Dubois traps" are similar in appearance to Beard and Dent's; they are drawn by hydraulic machinery the same as lead soil-pipe, and to my mind are superior to the cast-lead traps, being absolutely of one thickness throughout, perfectly smooth, and there is no chance of finding any small holes in them as we sometimes do in cast goods. In using the smaller sizes of these traps, whether cast or drawn, it is always better to have them with a cleaning screw such as may be seen at A, Fig. 7, for facility in clearing, should they at any time become choked. Nothing less than a 4-in. trap should be used for fixing under a water-closet, and it should be soldered by a wiped joint to a lead branch pipe passing through the wall to the soil-pipe outside. If the closet be some distance away from the vertical soil-pipe, so that this branch exceeds 4 or 5 feet in length, it will be better to solder in a 2-in. lead pipe as shown in dotted lines at A, Fig. 5, for the purpose of ventilation. This pipe may be carried above the roof independently of the large soil-pipe ventilator, or may join that pipe at a point above the highest water-closet branch.

This minor air-pipe will prevent syphoning in the trap, and will also carry off any foul air which may accumulate in the branch pipe.

Not very unlike in appearance to these traps is Hellyer's "Anti-D trap," as may be seen at Fig. 8, but this has a square outgo, which renders the trap less liable to be unsyphoned.

Waste-pipes from baths, sinks, lavatories, etc., should pass at once, if possible, through the wall into the open air, and discharge—if they be fixed upstairs—into an open head, which in turn carries the water by means of an iron pipe to the ground level, where it is discharged into an open gully-trap; Fig. 9 illustrates plainly enough what I mean.

It will be seen that the short lead waste-pipe is trapped immediately under the bath. This is not absolutely necessary, as there is no danger to be feared from the air which might pass up through this pipe if left untrapped; but there is no doubt it will be very unpleasant to the sense of smell, for the soapy slime which will be sure to collect round the inside of the pipe smells very nasty.

Jennings has brought out a trap for baths, etc., which, in addition to the usual water-seal, has a ball which floats against the inlet pipe and prevents any back pressure of drain air from entering the house that way; but the security afforded by this trap is not needed if the waste-pipe discharges into the open air; and if it be feared that the wind will blow into the pipe, a copper hinged flap should be soldered to the end of it. If the waste-pipe has to be carried down inside the house, it should be entirely of lead, and an air-pipe of sufficient size should be carried from the highest point near the

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trap to the roof: at the foot a gully-trap should be fixed as before explained.

The traps which have been described up to now are only fit to be used in connection with the internal sanitary fittings of a house, and are, therefore, the only sort with which the plumber has really anything to do; but we often find that the plumber who has to fit up the interior, has also to superintend the laying of the drains outside, so it is well that he should thoroughly understand the work throughout.

In the first place, as regards the drain, the pipes should be made of stoneware well glazed, perfectly smooth within and accurately round.

All junctions or branches with the main house drain should be made at an acute angle running in the direction of the current. The joints are best made with cement, care being taken that the spigot end of one pipe goes tightly up to the end of the socket in the other, so as to leave no ridge or space inside to cause an obstruction. The drain should run straight from point to point, and at every change of direction some means of inspection should be provided.

This is best done by fixing an open channel bend as shown at Fig. 10, and carrying up a square brick manhole to the surface, covered by an iron grating or solid cover; such channels may be obtained of Messrs. Doulton & Co., Lambeth, who make them at a variety of angles.

As regards the size of house drains, as a general rule, 6-in. pipes for the main drain, and 4-in. pipes for the branches, are the most serviceable. In the case of a very large mansion, it may sometimes be desirable to lay 9-in. pipes, but it must be borne in mind that it takes a large quantity of water at a great velocity to thoroughly flush a drain of this size. For this purpose, an automatic flushing tank placed at the head of the drain answers capitally, as by this means rain-water, and the wastes from sinks, etc., may be collected and discharged with great force through the entire length of drainage. Every long drain with many branches should be thus flushed.

One of the best contrivances for this purpose is Mr. Field's tank, shown at Figs. 11, 11A. The wastes from the sinks, etc., should discharge over the grating into the small trap, A, which is movable, and thence to the body of the tank, B. The outgo is in the shape of a syphon, C, and, when the tank is full, the water overflows through the longer leg, starting the syphon and emptying the contents of the tank quickly into the drain. Messrs. Doulton & Co. also make a capital flushing tank, both in stoneware and galvanised wrought iron. These traps also act as grease-traps for preventing the kitchen grease from entering the drain in solution with hot water, as the cold water in the tank congeals the fat as it enters, and leaves it floating after each flush. The accumulated grease should be removed periodically, or the result will inevitably be a stoppage. A most serviceable trap for receiving surface-water, rain-water, and the various wastes from sinks, etc. (but not scullery sinks, as the water from these often carries grease with it, and which should be treated in the manner mentioned above), is the gully-trap shown at Fig. 12, and in section at Fig. 9. It should be provided with a galvanised iron grating, and, if possible, the rain-water and wastes should enter by means of a bend into an inlet at either the back or on one side of the trap. By this means the splashing, which is inevitable when they empty over the top of the grating, is prevented, and greater facility is offered for inspection and cleansing. The surface-water from the yard or area where it may be fixed can enter through the iron grating at the top of the trap.

The soil-pipe, or W.C. waste, should be connected with the drain by means of an obtuse bend at its foot, and the drain from this point should run in as direct a line as possible for the sewer. After the drain has passed all points of junction of branch drains, a syphon or trap should be fixed, to thoroughly disconnect all air communication between the house drains and sewer.

A large variety of traps are made for this purpose, but one of the best is Hellyer's "Drain Sentinel," shown at Fig. 13. The inlet is in the form of a channel, thus affording a large inlet for air to the house drains. This trap should be fixed in a disconnecting air chamber, as may be seen in section at Fig. 14. A manhole, or air chamber, of ample size is built up to the surface, of brickwork, and a channel-pipe, B, is laid at the bottom of it, receiving the house drain and emptying into the "Drain Sentinel," A.

This channel-pipe may be had with branches if necessary. The floor of the air chamber should be sloped from the sides to the middle, and the inspection arm, C, should be stopped with a plug or movable stopper. The arm at D may be similarly stopped, or a pipe may be carried from it to ventilate the drain on that side of the trap.

The top of the air chamber may be covered by an iron grating or a solid cover. In the latter case, one or two 4-in. pipes should be carried up from the air chamber as E (Fig. 14).

Messrs. Doulton & Co. have a trap which they call the "Kenon," in connection with which they make an air chamber floor of stoneware, well glazed, which has a 6-in. channel passing through the middle, with side inlets for branch drains, if necessary. It is very useful for places where the workman does not understand how to construct the floor himself.

Messrs. Dent & Hellyer have a trap, called the "Ventilating Drain Syphon and Sewer Interceptor," which will give great satisfaction, if properly fixed. It is shown at Fig. 15. It consists of a round pipe trap with a 2½-in. water-seal. The body of the trap is comparatively of much smaller diameter than the inlet, for the trap to hold as little water as practicable. The inlet is about 6 in. above the water in the trap, so that the discharges fall almost vertically, changing the water by a very small flush. The upper part of the trap is enlarged for the admission of air into the house drain, and is surmounted by an iron grating. When this syphon is situated near a window or door, it is better to replace the grating by a stopper, and a 4-in. air-pipe should be carried from the air chamber to a wall remote from the window or door.

It is not absolutely necessary to increase the size of the trap or syphon for the air inlet, and a very decent job and a cheap one may be made with a 6-in. stoneware P trap with an inlet at the back, using the upper inlet for ventilation.

In any case, the sanitary arrangements of a house should be so contrived and constructed in the best and simplest possible manner to use freely those deodorisers and disinfectants which Nature itself supplies: namely, water and air. These are, or ought to be, common to all in a pure state, though it too frequently happens that both the one and the other are contaminated by man's culpable agency.

LATHES FOR EVERYBODY

BY SELF-HELPER.

THE construction of the bed and frame will not be found to be difficult by anybody who has succeeded in making the heads, as I have described; but, to make a good job, none of the work must be carelessly executed, as want of steadiness in this part will prove fatal to all good work in the lathe.

For the bed and legs, it would be well to have the wood 4 in. × 3 in., but slightly lighter stuff could be made to act. It is well, however, to have everything rigid and very strong.

From Fig. 2 it will be seen that each leg consists of two pieces mortised together so as to form a T. To keep the legs as rigid as possible, I got stays forged from iron 1 in. × ⅜ in., and, having japanned them, fastened them to the woodwork with ⅜-in. bolts. These stays were made of one piece, bent into the shape of the letter V, and so high as to let the centre upon which the crank hangs pass through their apex. The tops of the legs must be carefully cut away from each side, leaving a shoulder, upon which the sides of the bed may rest.

Two bolts at each end will then secure the bed and legs in place. The top of the bed must now be perfectly flat and out of winding. Each cheek must be the same depth, so that the under part of the bed will be flat; and the shears must be exactly 2 in. apart, the same at each end, and at every point between. If the headstocks have been made exactly, the tenons will be found to fit nicely into the space for them in the bed.

The frame will now be found to be fairly steady, but it will require some stretchers connecting the legs together, so as to prevent the pressure of the centres on the crank axle from pushing them apart. The front one may be a piece of iron 1 in. × ¼ in., lying flat on the ground, and fastened to the bed with wood screws, as shown.

As the treadle will be hinged to the other stretcher, it will require to be somewhat stronger.

I used wood 1½ in. × 2½ in., and let it into the ends of the cross pieces of the legs, as seen in Fig. 2. A couple of little bolts secured it very firmly. The stand is now ready to mound the flywheel and crank shaft. That used for this lathe was bought, the flywheel being 27 in. diameter, with four speeds, and one small speed for metal work. The throw of the crank is 2½ in., which, doubled, makes 5 in. from the highest to the lowest point. Then the pitman comes to a point in the treadle halfway between the hinge and the place the foot rests on, so that the treadle rises 10 in. in front, which I find to be a fair allowance for a lathe of this size.

The centres on which the crank is hung can be purchased for about 1s. 6d. a pair, and it would not pay to make them at that rate. It is not a difficult job in any case. A piece of ⅝-in. steel is screwed, and a cone turned in the lathe. The point is then hardened. The centre holes in crank should be bored deeply with ⅛-in. drill, and it would be better if they were bushed with hard cast steel.

Instead of the bent crank shaft and pitman, a straight shaft and external cranks could be easily used. Bessemer steel 1¾ in. diameter would do for the shaft. It should be hung on plummer blocks, which could be either purchased complete for 3s. 6d. each, having 1 in. bearing, to which the shaft would be turned down; or else cut from

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lignum vitæ, like Figs. 5 and 6; or else cast in patent metal like the same figures. Figs. 7 and 8 show the external cranks. They are best made in cast iron, but I have often used pieces of plain bar iron, about § in. thick, for cranks.

If this plan is employed, the back stretcher should be so long as to project beyond the legs three or four inches at each end.

The treadles, one at each end, would be plain bars of wood, 3 in. × 1½ in. × 2 ft. 6 in., hinged at one end to the stretcher, and attached to the pitmans at the middle. In this manner, both treadles would rise and fall simultaneously, and if a bar of sufficient length were screwed to both, we would have an efficient treadle the entire length of the lathe. Since the treadle thus formed would be supported at each end, there would be no tendency in it to get into winding by the pressure of the foot; but, when a treadle is supported by only one joint in the middle, the pressure of the foot on one corner tends to push down that corner and raise the one at the other end, and a treadle on this principle must be made very strong indeed to bear the irregular stresses upon it.

I supposed, in my former article, that the mandrels were not inserted in the headstocks until this stage of construction was reached, the reason being that it is difficult to ascertain their exact position in the headstocks. A templet of tin can now be made, like Fig. 2. The space in the lower part justs fits between the bed, and the point, c, is just over the middle and 5 in. from x.

To use this templet, the headstock is placed on the bed in the position which it is to occupy permanently, and the templet placed against one face. A point is then passed through a little hole at c, and marks in the headstock the position which the centre of the mandrel is to occupy finally.

The templet is then, *without turning it*, placed against the surface at the other end of the headstock, and the position of c transferred to that end likewise. The same operation is gone through with the other headstock, taking care to have the same surface of the templet always pointing towards the same end of the frame.

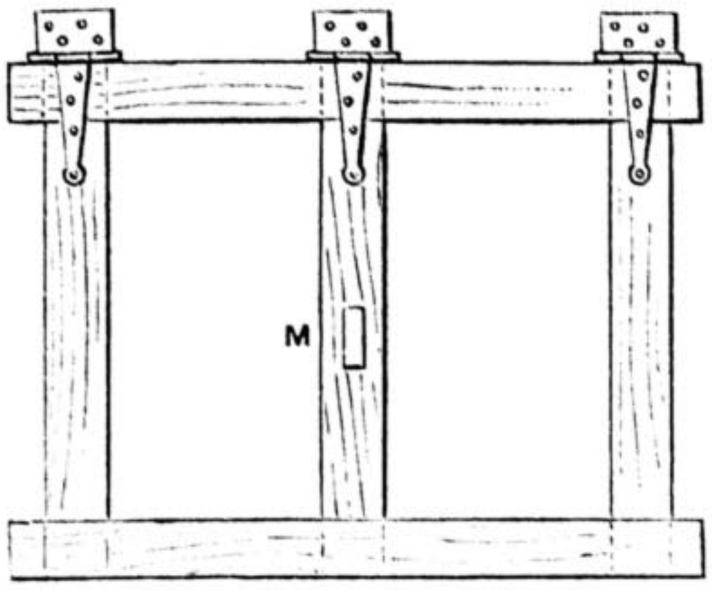


Fig. 1.—Plan of Treadle.

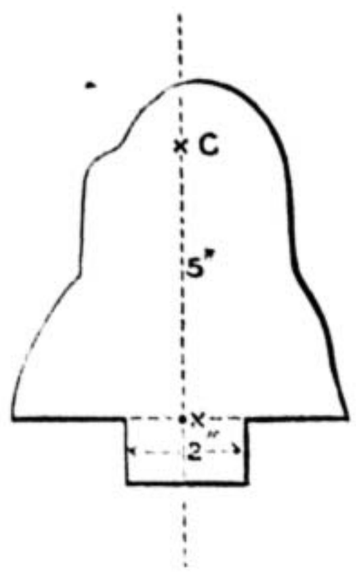


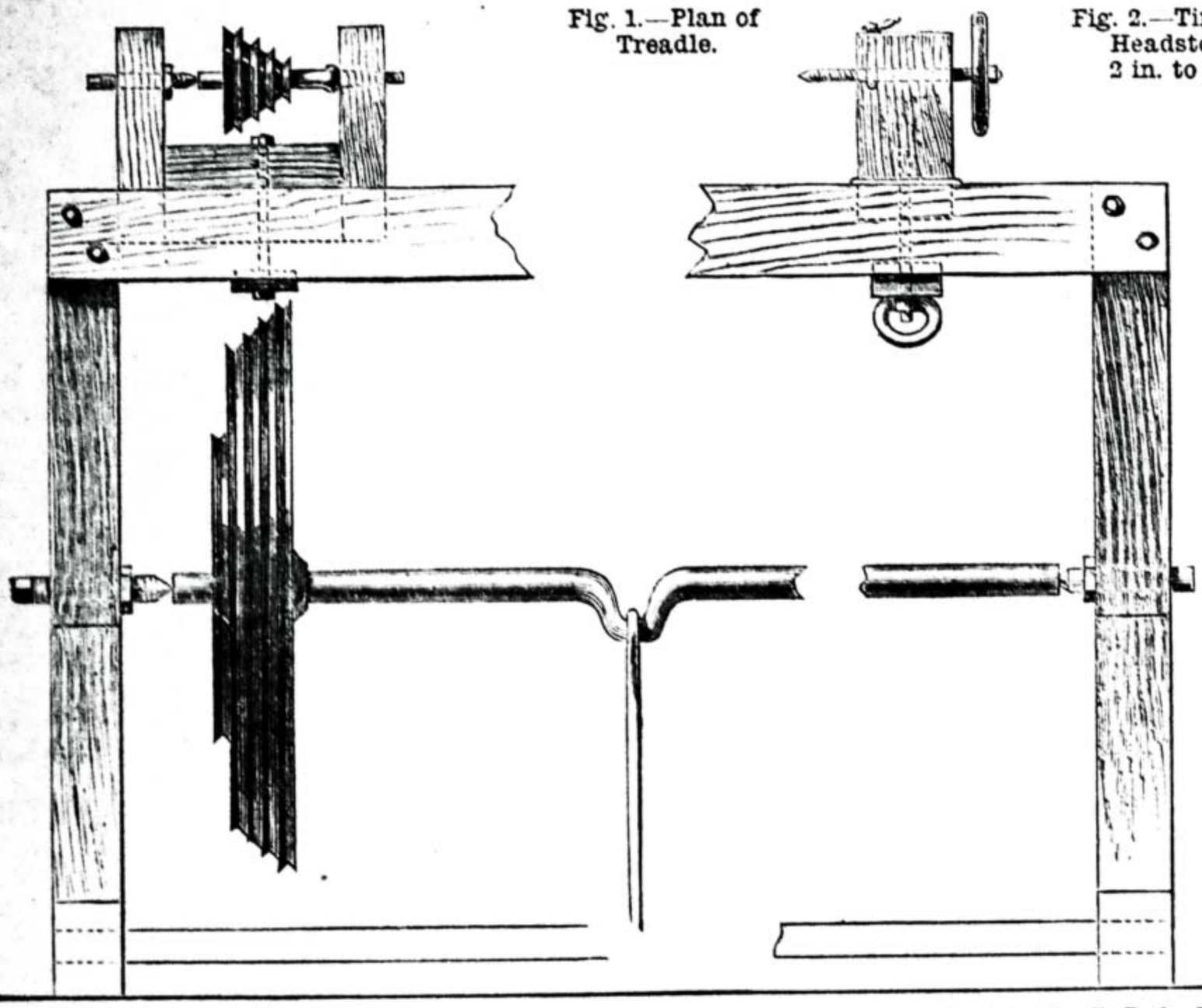
Fig. 2.—Tin Templet for Headstocks. (Scale, 2 in. to 1 ft.)

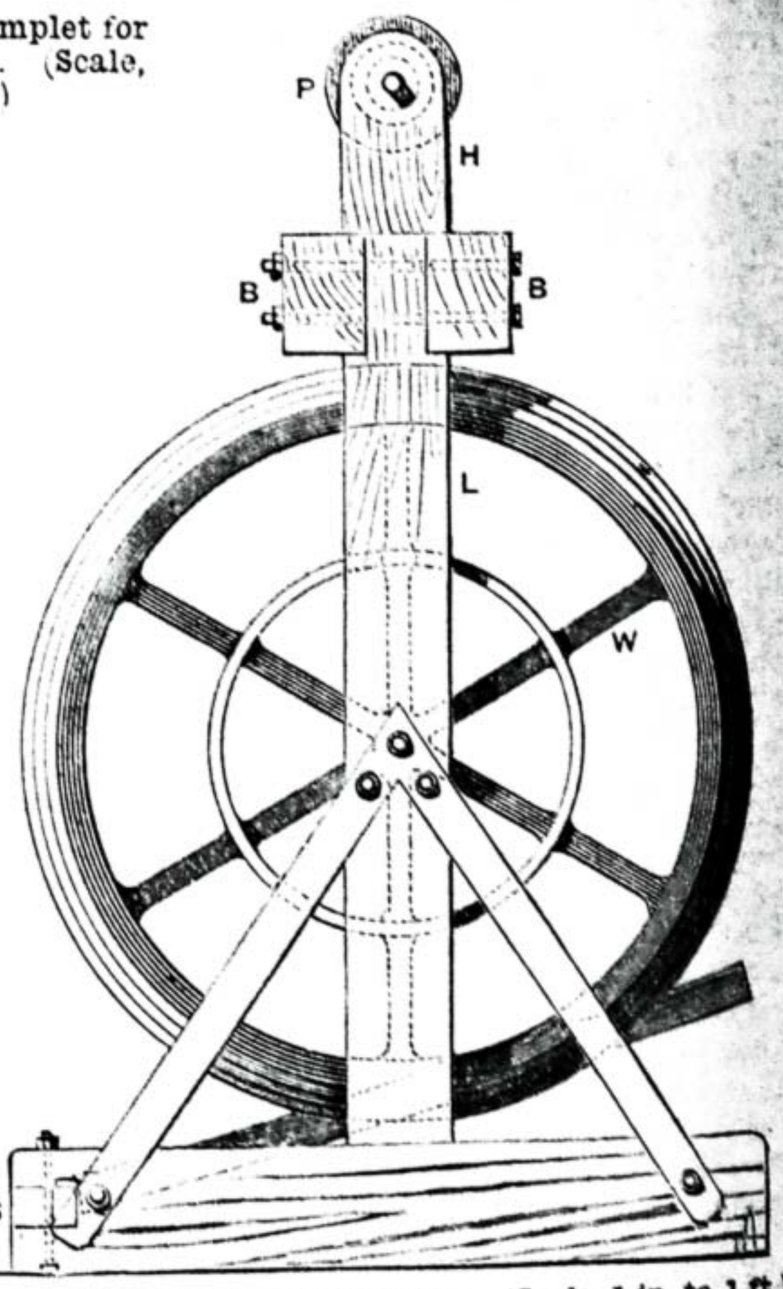
The treadle for the bent crank shaft is simply a frame like Fig. 1, about 18 in. shorter than the bed, and 2 ft. 3 in. wide. The position of the central member, M, is determined by that of the dip in crank axle. It should be directly under it. There is a mortise cut, through which the pitman passes, and a ⅜-in. bolt across will serve as a pin, on which the latter hooks. The wood for this form of treadle would be 1½ in. × 3 in. or 4 in.

The pitman I used was a plain rod of ½-in. iron, bent at one end to embrace the crank, and, at the other, the pin I mentioned. It was filed flat at the bends, so as to afford a better bearing, and case-hardened. It was then japanned.

This lathe, as I have described it, worked remarkably well. It took a great deal of time, however, to make, as everything was finished in the best possible manner. If any of my readers wish to proceed more economically, all the woodwork may be made of beech, or even deal, and the lathe will still work well. Instead of the coned brass bush for the front mandrel bearing, I have used, on occasion, patent metal, pouring it into a hole in the headstock, the mandrel being held in its proper position. This is much easier to accomplish than boring a gun-metal bush, and works quite as well.

I trust that what I have said will induce many readers of WORK to try their hands at lathe making, for, if they do, I am fully persuaded that it will be of the greatest possible benefit to them in their after life.





Figs. 3. —Front View of Lathe. Fig. 4.—End View of Lathe—P, Pulley; H, Headstock; B, Bed; L, Leg; W, Flywheel; S, Stretcher. (Scale, 1 in. to 1 ft.)

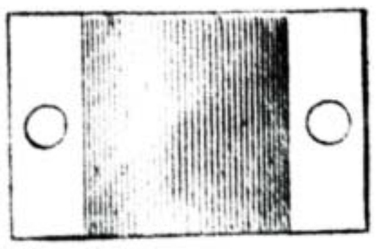
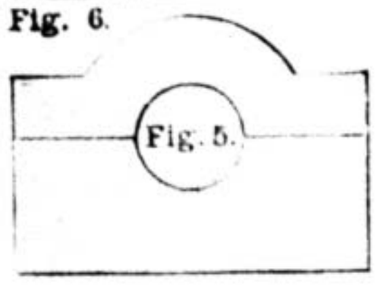


Fig. 6.



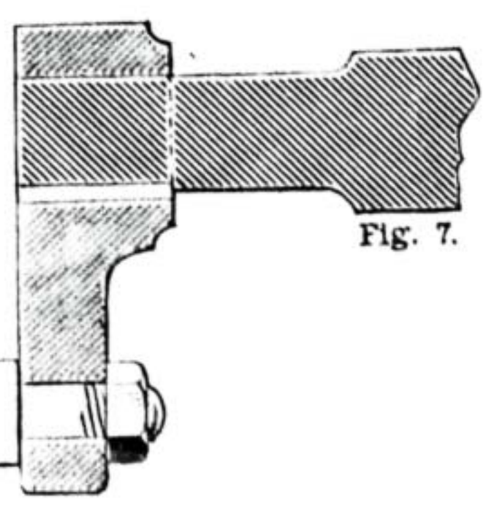


Fig. 7.

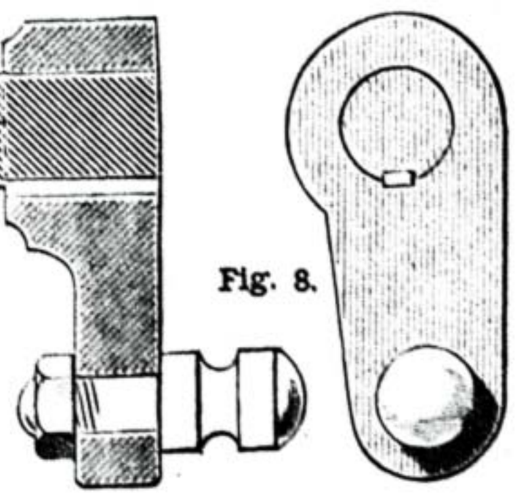


Fig. 8.

Figs. 5 and 6.—Plummer Blocks. Figs. 7 and 8.—External Cranks.

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THE KALEIDOSCOPE: ITS CONSTRUCTION AND APPLICATION.

BY THOMAS RICHARDSON.

THE CASE AND INTERIOR MECHANISM OF THE COMPOUND KALEIDOSCOPE (*continued*).

(*For other Illustrations to which References are made in this Paper, see Pages* 424, 425.)

As arranged at the close of the last article, our next proceeding is to set out the fillets to which the sides of the case are to be screwed. They are $\frac{3}{8}$ in. thick, and are fixed flush with a line gauged all round $\frac{3}{16}$ in. from the edge, as shown in Fig. 2. As the interior of the plates are duplicates of each other, two sets are required, and the fillets at both ends are cut away in places, to clear the mechanism of the lower part of the arms (K K, Fig. 5), also on the front plate alone, to clear the lever, L. Having fixed the fillets, we next prepare the sides of the case, not forgetting a previous remark respecting the character of the wood to be used for the purpose. As this affords an opportunity for the display of good workmanship, I may here pause to remark that as, in many workshops, the same bench does duty for all classes of work, whether rough or smooth, it is just possible that the last job may have been of a coarse description—such as the repair of garden utensils or work of a like character—the consequence being that particles of a gritty nature have become embedded in the bench-top, rendering it extremely difficult to avoid scratching the surface of such work as that in hand. Presuming that the worker wishes to escape these troubles, he is hereby advised to procure a piece of deal, 3 ft. long, 11 in. wide, and 2 in. thick. Plane up one edge, and fix to the bench with screws at each end, the heads being sunk well beneath the surface, so as to clear the plane in trueing up for the present, and on any future occasion when necessary. Supposing the face to be true and level, we must provide a stop by cutting a dovetail, tapering groove $\frac{3}{8}$ in. deep across the grain about 2 in. from the end. Into this groove is to be tightly fitted a piece of hard beech, $\frac{5}{8}$ in. thick, $1\frac{1}{4}$ in. wide at one end and 1 in. at the other, the groove being dovetailed so that the bottom is $\frac{1}{4}$ in. wider than the top. When so fitted, the front edge of the stop against which the work is to abut must be rabbeted square with the front edge of the board, and perpendicular to its face.

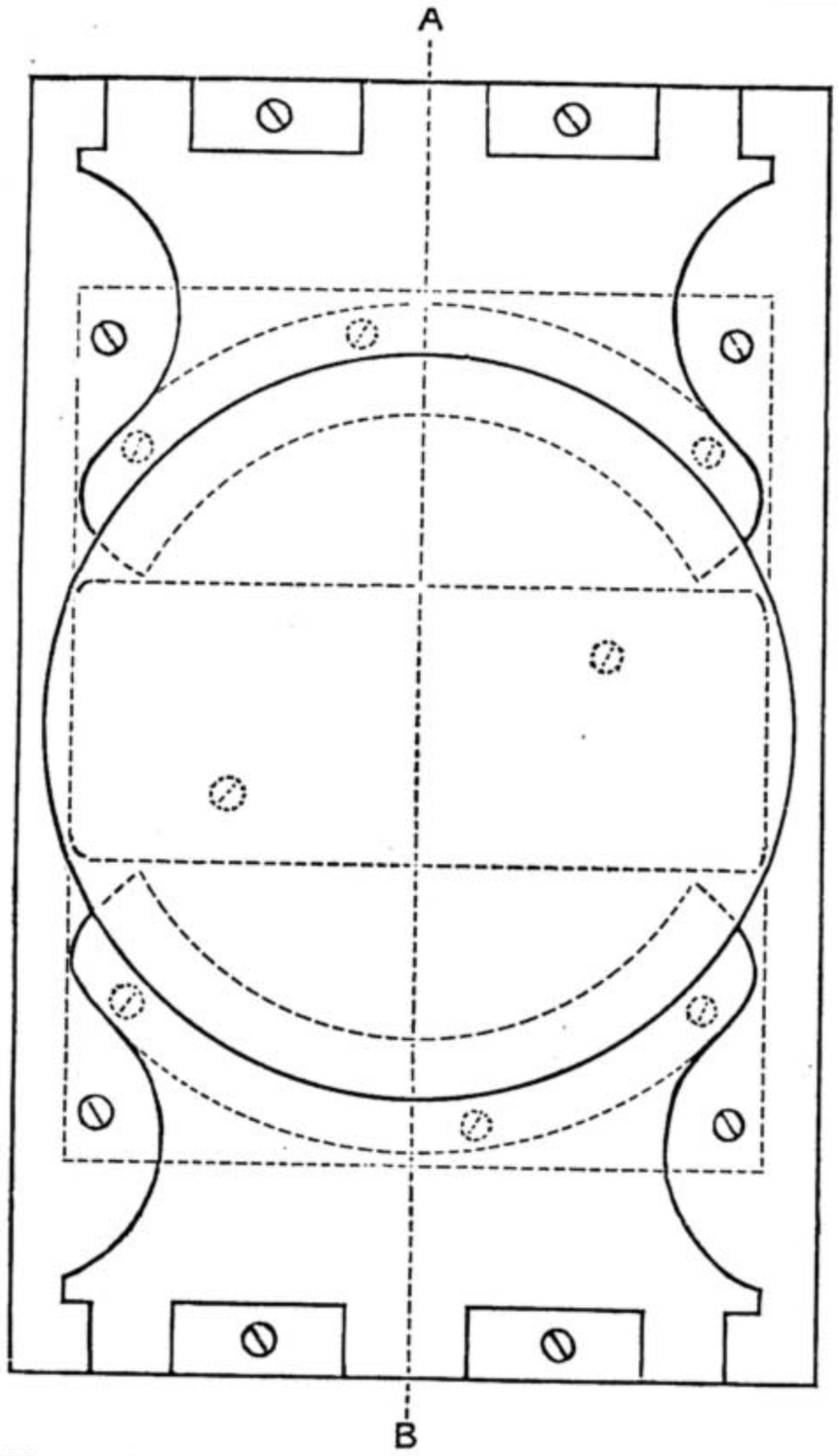

Fig. 6.—Diagram showing Method of Mounting Uprights and Segments in Lathe for turning them out of Solid Piece.

To proceed: The pieces composing the sides should not be less than 9 in. long and 4 in. wide; have a keen edge on the trying plane, with the back iron set close, and plane up each piece carefully to $\frac{1}{4}$ in. thick; then square one edge, and set off the rabbet at each end so as to support the ends of the case at a distance of $8\frac{1}{8}$ in. apart. As it is important to have all exactly of the same length, scribe a line across one end of each piece with the cutting end of the scriber; the distance from this to the second line is then gauged with a pair of compasses, and, having also gauged a line to the depth required, run a saw-cut across just outside the lines, and finish with a paring chisel. In order to shoot the edges to the correct angle, we must arrange matters as shown in Fig. 7, where the board already attached to the bench is utilised as a base on which to construct a suitable tool for the purpose. In the first place, observe that the stop is removed; the baseboard (A) is chamfered on its front edge, and to this is hinged a board (B), about 18 in. long, 5 in. wide, and $1\frac{1}{2}$ in. thick, the hinge being attached $\frac{1}{4}$ in. below the face of the board; over this another strip (C) is screwed, in order to raise the work within reach of the plane iron. In this latter piece a stop is required, similar to that in the baseboard; and the adjustment to the correct angle is effected by means of a pair of wedges (D, D), having each a mortise cut in the centre, so that they can be clamped to the bench by a round-headed screw and washer. The mode of using the above appliance will be obvious from the position of the hands as shown in the illustration, the work being held and pressed against the plane by the thumb of the left hand, whilst the plane is firmly kept to its work by the right as it slides in the angle formed by the bevelled edge of the board (C) and the base. In this way the sides can be truly planed to an angle of about 67°. As these will, probably, vary a trifle in width, it is only required, for the present, to bevel the edges which have already been straightened. They are

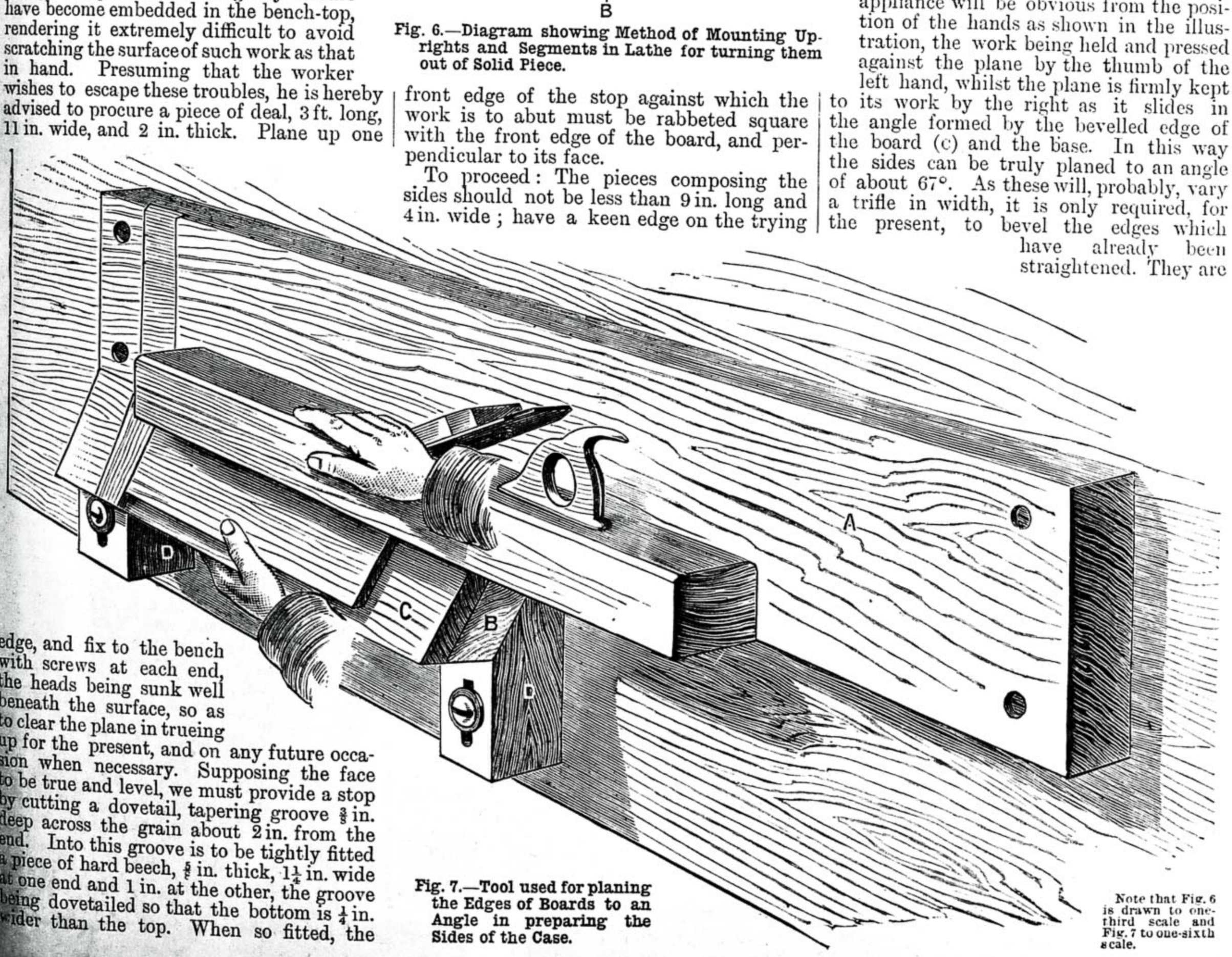

Fig. 7.—Tool used for planing the Edges of Boards to an Angle in preparing the Sides of the Case.

Note that Fig. 6 is drawn to one-third scale and Fig. 7 to one-sixth scale.

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attached at each end by three round-headed brass screws, ½ in. long, and it will ensure regularity, and greatly enhance the finished appearance, if the holes are set out with the square and compasses. In order to preserve the parallelism of the two plates while the sides are being fitted, we shall require a temporary piece to act as a stay; it is about 3 in. wide, rabbeted squarely at the ends to the correct length, and screwed to the flat at 1 (Fig. 2), its true edge being, of course, coincident with the angle of the plates. Now, secure the first side temporarily to the opposite flat with two screws at each end, its true edge being also carefully placed at the extreme angle on the right of Fig. 2. Here it will be noticed that an opportunity offers to rectify any little error or defect in the working of the slides, as hinted towards the close of the last article, seeing that the plates are now held parallel, and the interior is easy of access. When satisfied that each part works quite smooth and regular, we may pass on to fit another side below the first, with their true edges adjacent. Having produced a perfect joint, fix with a screw at each end next the true edge, and mark off the width at the angle below; then unwind the screws and bevel this edge to the mark. When this second side is secured in position we must return to the first, mark the width at the angle, and, having bevelled the edge, refix, and proceed in the same way with the third, and all the rest in turn until the last is reached, when, to make the joint between the seventh and eighth, it will be necessary to remove the first of the series out of the way until the joint between the last two sides is perfect; then replace it, and reduce the last edge very gradually, lest the piece be spoiled in the attempt, finishing by trimming the ends off flush and very slightly rounding the edges. As we still require access to the interior, the polishing, etc., must be deferred, and two sides each from the top and bottom of the case must be removed, the inside of each being marked with a ⅜-in. chisel in Roman numerals to denote their respective places. Placing these out of reach of injury, the circles at x, x (Figs. 1, 2, and 5) now claim attention. They are prepared from half-inch close-grained mahogany, and the easiest method will be to turn them out of the solid, as shown, by mounting on a chuck with the screws passing through holes set out on a circle 6⅜ in. diameter, the same being used eventually to attach them in position. All necessary holes are bored of the proper size before the surrounding substance is materially reduced, to avoid risk of splitting. To lessen waste of material, the interior portion may be removed with a thin parting tool, and reserved for constructing the eye-pieces later on. It is scarcely necessary to remind the worker that both sides of each ring should be trued up in the lathe, as it is of importance that they be of the same diameter externally and internally, and also of even thickness throughout, to ensure a smooth, even movement. By fitting a slip of wood in the opening at each end of the case, a centre may be found, and a circle described to coincide with the interior of the rings, and their correct appearance and position ascertained from Fig. 1.

The two uprights (v, v, Figs. 2 and 5) are turned out of one piece of mahogany, 12 in. long, 8 in. wide, and ½ in. thick; one side is planed true and level, and also one edge; it is then secured to a chuck in the manner denoted by the *full* lines in Fig. 6, and a centre line (A B) scribed on the face parallel to the true edge through the centre found as it spins in the lathe. After being turned to the proper thickness, the opening is bored true and square to the same diameter as the outside of the rings, which may be used as gauges in the operation. In the preparation of the two segments (w, Fig. 2) we may economise the mahogany by attaching a piece of deal, 2½ in. wide and 1 in. thick, across the centre of the opening in the uprights already on the chuck, and, on each side of this, a piece of mahogany 6½ in. long, 2¾ in. wide, and ½ in. thick, the position of each being indicated by the *dotted* lines in Fig. 6. The inner curve on these segments is the same as the rings, and the outer edge is rounded as in Fig. 5. When this is accomplished, two pieces of brass plate, 6⅛ in. long, ¾ in. wide, and $\frac{1}{16}$ in. thick, are bent to the proper curve, and fixed to the segments by fine ½-in. screws, inserted about 1 in. apart. Now proceed with the base plate (u, Figs. 2 and 5): Plane to ½ in. thick, and set out the mortises at each end, with the inner edges $\frac{1}{32}$ in. in excess of the length of the case; then the shoulders of the tenons are squared from the true edge of the piece and fitted to the base, to ensure their being firmly put together without fear of splitting; after which, a moulding is worked round the upper edge of the base, the case is laid on end on the bench, and the segments secured to the uprights, which have been well rubbed on the curves with blacklead, a slip of paper being interposed between the brass and the ring to avoid pinching. On removing the paper, the groove thus formed should slide smoothly over the rings. In providing the clamping action at F (Figs. 2 and 5), the instructions already given will apply to the milled head, which has a screw projecting about ⅛ in. diameter, the small casting being tapped to suit, and the boss on the under-side let into the segment. The point of the screw bears on the free end of a thin spring of hard brass, 1¼ in. long and ⅜ in. wide, secured in a recess by a small screw at the opposite end to that at which the pressure is applied. When all these little operations have been effected, the uprights can be cut to the outline in the figure, and finally glued to the base, especial care being exercised to be certain that they are exactly perpendicular to the base, after which, if deemed advisable, the joint may be further strengthened by passing a fine screw, about 1 in. long, obliquely upwards on each side of the central tenon, and 3½ in. apart. This completes the stand and exterior of the case, with the exception of two brass clips, one of which is seen at Y (Fig. 2), which secure the object-box carrier to its seat; and four little handles, as at *m* (Fig. 1), having pins, which are fitted and glued in ¼-in. holes bored in the centre of the length and breadth of each alternate side.

We must now retrace our steps somewhat, and prepare the limbs (*a* and *b*) which compose the arms (K, K, Fig. 5). As there are four of each, we require for the lower set a piece of beech or hornbeam, 17 in. long, planed to 1⅜ in. wide and ⅞ in. thick; and, for the upper, a piece of the same thickness, but 14 in. long and ¾ in. wide. At ⅜ in. from the front edge, a line is gauged on both sides, and on this the holes are set off and bored true and square, the upper set being bored to fit the tube which encloses the pinion, and those in the lower set to fit the tube enclosing the steel rods. One from each set must now be cut off, and pared to the form shown in the drawing, so that, on inserting a tube in the holes, they can be used as patterns from which the outlines of the rest can be marked, being careful to have each set of equal length, measuring from the edge of the hole to the point at which the two limbs are hinged together; and, in particular, the bevelled faces must be cut to the same angle; after which, grooves along the centre of these faces are set out, and cut ½ in. wide, and a little over ⅛ in. deep. Now halve the upper set at the top, as shown, removing sufficient to enable the inner edges to form an angle of 90°. A brass butt hinge connects the upper limb to the lower, and as the countersink is reversed in one set of holes, the screws must be replaced by those of a round or mushroom-headed pattern. If this is properly done, the upper limb will move freely round on the hinge when the lower is pressed flat on the bench, either side up. It will be well, therefore, to apply this test as each screw is inserted. Held against the lower edge of the hinge by a screw is a piece of brass having a slot cut the width of the screw at *d*, which is used to clamp the table (*c*, Fig. 5) to the arm after adjustment by the screw at *f*, the wood being mortised to match the slot in the plate, to allow of the necessary movement. To complete the arms, we require four brass brackets (*f*, *f*, Figs. 2 and 5), fitted with a screw ¾ in. long, and a spiral spring of hard drawn brass wire, about No. 18 B.W.G.

Our next business is the preparation of a table, or base, on which to mount the mirrors, and, at the same time, capable of slight motion up or down the inclined face of the arm, and of being securely clamped to the same. In dealing with this portion, we will take but one side, and assume that the two will proceed simultaneously, and we will further suppose that the stuff will be prepared in such a way that all similar pieces shall be cut from one length, which has been planed to a suitable width and thickness. The principal part of this mounting is the strip (*c*, Fig. 5). This is of mahogany, 8 in. long, 2 in. wide, and $\frac{3}{16}$ in. thick on the inner face, and at ⅝ in. from each end a piece of mahogany 1$\frac{5}{16}$ in. long, 2½ in. wide, and $\frac{3}{16}$ in. thick, shown in section at *e*, and in elevation by the dotted lines in Fig. 5, is attached by four small screws. These latter pieces prevent warping and twisting of the table, to support which in a longitudinal direction, and also afford a hold for the screw at *f*, a strip of beech, 7½ in. long, ½ in. wide, and $\frac{5}{16}$ in. thick, is attached by eight screws, 1 in. apart, the outer screws being ¼ in. from the ends. Previous to fixing this in position, lines must be scribed square with the edge, and $\frac{11}{16}$ in. from each end of the strip *c*. Just within these lines, and abutting against the last-mentioned piece, are two slips of beech, ⅛ in. thick, and of the same width as the grooves on the inclined face of the arm; these are held by a small screw at each end, and are slotted to match the mortises, and thus clear the screw at *d*. To support the lower edges of the reflectors, at *i*, *i*, are seen two pieces of beech, ¾ in. long, ⅞ in. wide, and ⅛ in. thick, which are screwed to the base (*c*), the upper edge being held by the slip of beech at *h*, 7 in. long, $\frac{9}{16}$ in. wide, and about $\frac{3}{32}$ in. thick. Any difficulty experienced in planing the edges of such thin pieces may be overcome by holding the slip of wood in the fingers and drawing it towards you over the sole of the trying plane, which is placed, bottom upwards, in the vice for the purpose. Blacklead must now be applied to the grooves and their corresponding guides, and the screws at *d* inserted, the relative

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position of the two portions being exactly denoted in Fig. 5. On clamping the screws, we can ascertain the lengths of the tubes and thickness of the washers which maintain the arms at the proper distance asunder; at the same time we can determine the thickness of the pieces of mahogany at *j*, *j* (Figs. 2 and 5), which occupy the space between the arms and the ends of the case. On reference to Fig. 5 it will be seen that the tubes and pinions are secured in their respective position by screws or rivets passing through them; after which, the back plate may be taken apart from the sides, and the milled heads can be attached to the pinions which pass through from the inside of the plate—not forgetting the brass washers, which bear on each side of the plate—before finally driving the heads on to the tapering ends of the pinions. The whole of the mechanism may now be connected in readiness for the reception of the optical portion, the preparation of which will be treated in my next paper.

ENGRAVING ON METAL.

BY NORMAN MACLEAN.

Engraving on Britannia Metal.

It will be, perhaps, of some assistance if I enumerate the various branches of engraving on metal. Brass, zinc, and pewter have already been alluded to. The easiest, perhaps, is Britannia metal engraving; but even this metal requires a certain style to make a little work look effective. The work, too, is done very cheaply, and at first sight would appear as if it were impossible to earn a living at the price; but as many engravers do nothing else but work on the above metal, if they have plenty of work they have nothing to complain of at the week's end. The principal articles made in Britannia metal are tea and coffee sets, hot and cold water jugs, biscuit boxes, etc. These are usually engraved, chased, and engine-turned.

At the present time there is not so much engraving, as chasing and embossed work, with fluting in the Queen Anne style, is most in fashion.

Then comes the "hollow ware" engraver, who ornaments trays and waiters, tea and coffee services, dish covers, ice pails and jugs, *entrée* dishes, soup tureens, all of which are made in silver and German silver.

Another branch is the engraving of small work, such as fish carvers and eaters, dessert knives and forks, forks and spoons (not lettering or cresting), and general "odd work," which is also made in silver and German silver. Heraldic engraving is a branch—the highest, I may say, as it requires a skilful and accurate draughtsman, a steady hand, and remarkable patience. It includes the engraving of coats of arms, crests, monograms, and inscriptions on metal, and lettering and cresting on pearl and ivory. There are also the watchcase and dial engraver and the jewellery engraver. The young workman will be able to select a branch of engraving from the foregoing, but I would strongly advise him to make an arrangement with some *bonâ-fide* workman who would be willing for a consideration to put him in the way of sound practice, or, what would be better still, to take him as an articled pupil for a time. There is no royal road to engraving; it is only to be learned by constant practice and competent tuition. These remarks apply, of course, to the more artistic branches.

I will now make a few remarks as to the form or condition of the work as it is given out to the workman to be engraved. In the case of Britannia metal goods, they are invariably "made up"—*i.e.*, the article is made throughout, as for a teapot, being fitted with handle, spout, lid, and is, with the exception of engraving, ready for electro-plating and finishing. Other articles, such as for chasing, embossing, and engine-turning, are not so "made up," the condition being the same as that in which they leave the spinning lathe, and otherwise rough polished or buffed. In German silver hollow ware, these are "made up" to a certain extent: thus, a teapot would have the spout, foot or feet, lid, and mounts for the reception of the ebony or ivory handle, which is fitted after plating; and where the handle is of metal, the necessity of non-conductors of ivory, etc., make it imperative that the handle should be fitted after plating, as the ivory will not stand the acid of the plating vat. With plated table cutlery, the blades and forks are sent to be engraved before they are handled, as they require to be electro-plated before the handles are attached. And with heraldic engraving, it is both finished and unfinished when it reaches the workman's hands. Presentation articles are usually made by the manufacturers, who generally receive the order and particulars of inscription at the same time; then the engraver's work is done before the article is finished. But in the case of a present having been bought from a silversmith, the workman has to do his work in a careful manner, so as not to spoil the finish of the article, and for which, by the way, he charges accordingly.

Probably the cheapest thing in the market for a workman to try his hand upon is a twelve-inch brass waiter, either round, oval, or octagon. These may be procured ready for engraving from Mr. Samuel Groves, Broad Street, Birmingham, at a low price. These waiters, well engraved, plated, and finished, *should* command a ready sale in bazaars, etc. Having procured the waiter, the next thing to be considered is the design, which should be pretty and effective, with just enough work in the design to well balance it. There are many styles to choose from, but at present the workman will perhaps prefer to try the one found in Fig. 32, and which may be engraved in five sections. To "set out" the waiter, first warm the centre of the waiter, and rub a little beeswax thereon, and place a small piece of zinc—say, one-half inch square—on the wax while it is hot. This will cause the zinc to adhere, and prevent any marks consequent on the action of the legs of the compasses.

Now, with the compasses strike *faintly* all the circles needed for the pattern, then accurately divide the waiter into fifteen equal parts by stepping it round with the compasses. This will leave two divisions for the panel, and one division for the ivy leaf spray. Next cut the outside lines of the panels, using the dividers to trace the second line of the panel, by means of the outside line. Cut all these second lines, and you will have the required space in which to sketch the scroll work. To do this, draw a straight line down the centre of the panel, and sketch in truly, and afterwards trace it in with the point (Fig. 23, page 596), and outline only. Now sketch in the spray to the right, point in and outline, and proceed in like manner with the outside and inside borders. On the line down the centre of the panel cut an almost imperceptible dot or speck, so that you may know the exact centre. Now that we have got a section outlined, the next thing to be done is the taking of an impression in paper, termed a "white" or "dry" print. This is done in the same manner as the taking of an ink print, with the simple exception that we must use no ink. Use a pretty good paper, such as good white or blue unruled foolscap. Take off the paper, after you think you have got a good impression, and dry it gradually and thoroughly. The pounce bag here comes in. It is simply made by crushing fine an ounce or so of common whiting—see that it is dry—and then enclose it in a piece of well-washed linen. Now cut from the print all superfluous paper, and cut an oval-shaped hole in the top and bottom of the paper print exactly down the centre. Now draw a centre line down the remaining four panels, and rub just the least bit of candle grease on the surface of each, and also where the ivy spray is to come. The print now being ready for laying down, dust the pounce bag smartly on the print with the impression upwards, and "lay down" all the panels in turn. If the workman has been successful in dividing the waiter accurately, the pattern will fit exactly. The workman will observe that the borders are little else than outlining, thickening, and colouring, which will form excellent practice, while the scroll and leaf work will be an agreeable change. Work slowly at first, frequently pausing to see that the work is uniform. The leaves of the ivy spray may be "blacked" out with the "shading" graver, and lightly veined, and the panels blacked out with either the graver or the shader, according to the time it is desired to spend upon the work. The scroll work will not want much shading, and only judicious thickening. I hope I have made this clear to the young workman, who is supposed to know something about the treatment of ornament as far as regards the shading, etc.

In Fig. 33 will be found a sketch of a Britannia metal teapot, of a very old-fashioned shape, but which is now very fashionable. This pattern may be done either in first-class style or in a cheap and effective manner.

As the latter style will better suit the young workman, I will give a few brief directions how to proceed with the work, leaving the engraver to supply the details according to his individual taste, which the workman will do well to practice.

The chief ornament is the wide border, with arches and drooping fleur-de-lis. For the double lines of the top and bottom borders a double wriggling tool (Fig. 34) is used, this tool being made in many different widths. It consists of a flat or ordinary wriggling tool, with a groove cut straight down the centre, slightly "set off" and whetted on the back in the usual way. In addition to the ordinary graver will be required a large round-nosed tool for the "bright" leaves of the top and bottom borders; also a smaller one for the small spots; and a narrow flat tool or wriggler for the waved lines of the bottom border, and the waved line of the spray in the hollow section at the top of the teapot.

The tools being ready, rule two single lines as truly as possible, using the dividers, and the angle of the join where the hollow at the top of the teapot commences. Rule similar lines of the required width for the bottom border, using the bottom of the teapot for a guide. Now take a double wriggling tool of the proper width, and with a

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regular rocking motion of the wrist, push forward the tool, which will, or ought to, make a continuous dotted double line. All these double lines are done before putting aside that particular tool. Now change the tool for the narrow wriggler, and cut the waved lines on each side of the bottom border, and a rather deeper and bolder wave for the spray at the top of the teapot. Then take a wide shading graver, a No. 12, and cut away the whole of the space between the lines of the bottom border, cutting lengthways, and then it is ready to receive the bold cutting of the large round-nosed tool (Fig. 35), which will eventually take the form of "bright" leaves. To do this, after whetting the round tool, rub the tool on a piece of thick leather on which a little rouge has been sprinkled; this will make the tool cut bright. Draw a pencil line down the exact centre of the teapot, and cut the four small bright spots. Now step out with the dividers the intervals for the bright leaves, and form them with two cuts—a deep and bold cut, followed by a light one in the first to clear the cut, and also to bring it to its proper size. It will be seen that the points of the leaves in both borders extend from the centre, and are carried round the teapot as far as the spout and handle respectively. After the round tool has done its work, cut the oval form left by the round tool into shape with an ordinary graver, flanching, or cutting with the point and right or left side of the graver,

Fig. 34.—Belly of Double "Wriggling" Graver.

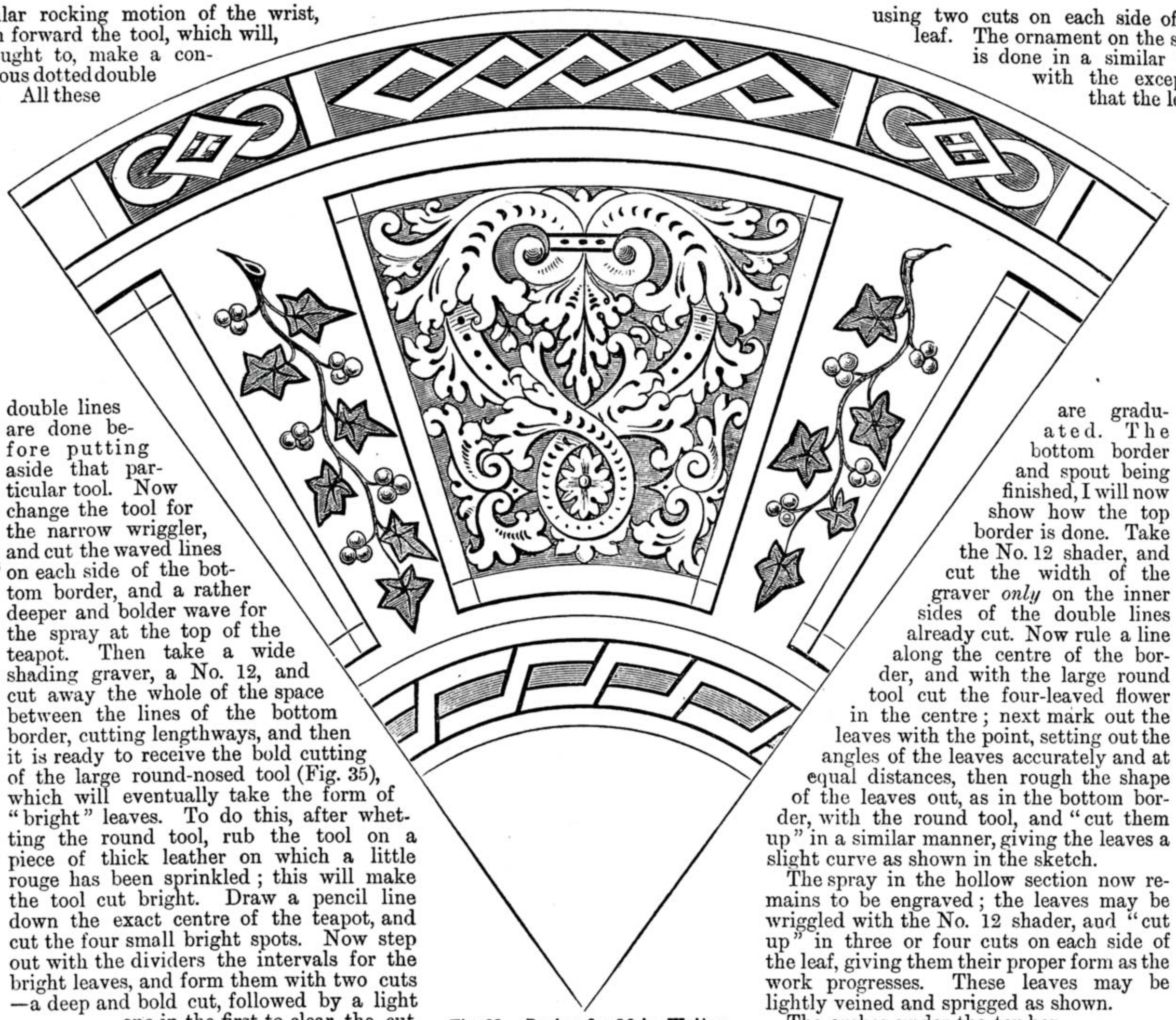

Fig. 32.—Design for 12-in. Waiter.

using two cuts on each side of the leaf. The ornament on the spout is done in a similar way, with the exception that the leaves are graduated. The bottom border and spout being finished, I will now show how the top border is done. Take the No. 12 shader, and cut the width of the graver *only* on the inner sides of the double lines already cut. Now rule a line along the centre of the border, and with the large round tool cut the four-leaved flower in the centre; next mark out the leaves with the point, setting out the angles of the leaves accurately and at equal distances, then rough the shape of the leaves out, as in the bottom border, with the round tool, and "cut them up" in a similar manner, giving the leaves a slight curve as shown in the sketch.

The spray in the hollow section now remains to be engraved; the leaves may be wriggled with the No. 12 shader, and "cut up" in three or four cuts on each side of the leaf, giving them their proper form as the work progresses. These leaves may be lightly veined and sprigged as shown.

The arches under the top border must be stepped out, and wriggled with the narrow tool used for the waved lines. The leaves at the points of the arches may be done (wriggled) with the No. 12 shader, and cut up in the same style as the spray in the hollow. A small spot between the arches, and a large spot with smaller one beneath in bend of arch, complete pattern. The work on lid is outlined with graver and finished with shader.

Fig. 35.—Belly of Large Round-nosed Graver.

Fig. 33.—Design for a Queen Anne Teapot.

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SIGN-WRITING AND LETTERING.

BY HENRY L. BENWELL.

BLOCKED LETTERS—THICKNESSES—CAST SHADOWS—SHADOWING—LIGHT AND SHADE—TUSCAN AND TABLET ALPHABETS, AND HOW TO TREAT THEM.

THE laws of light and shade play a very prominent part in the more advanced stages of our art, especially to the more practical branch of ornamental lettering; therefore as regards importance, this subject follows very closely upon the heels of perspective. We will leave this matter, however, until the latter part of the chapter, and first of all consider the raising and blocking of letters, and other work which always precedes the shading proper. I had better, perhaps, before proceeding further, explain the meaning of one or two technical terms, so that the novice may be able to thoroughly comprehend their meaning whenever they are mentioned in this chapter.

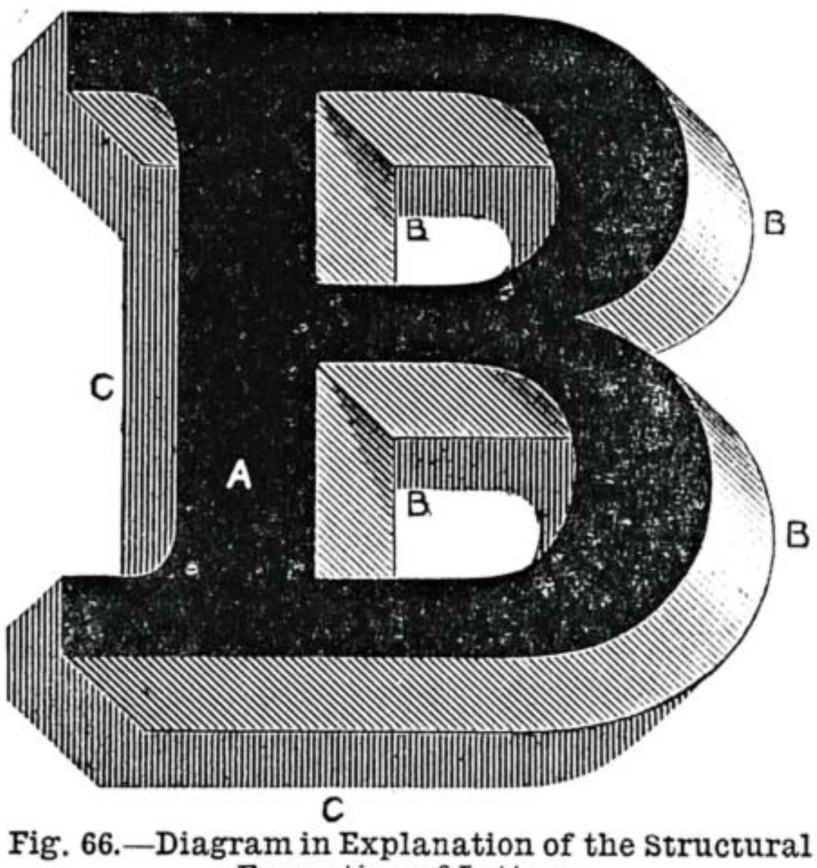

Fig. 66.—Diagram in Explanation of the Structural Formation of Letters.

Fig. 67.—Tablet Alphabet, Capitals, Numerals, Points, etc., to Illustrate Method of Shading Letters.

A "blocked" or "raised" letter is one which appears, or stands out in relief, such as the manufactured wood letters previously referred to, and which it is the work of the sign-writer to imitate on a flat surface by skilful perspective and colouring. A "double blocked" letter is one which is blocked out on both sides, or internally and externally. The "thickness" is the two sides or edges, and the two ends of a blocked letter; but of course, from whichever way such a letter is looked at, only one side and one end are visible to the eye at one time, and as letters are generally looked at from below, and commonly shaded on the right, the bottom and right sides of the letters are usually those where the thickness is given. Of course, it must be understood that we can put this thickness on either side of the letter, or at the top or bottom, but we cannot put it on both sides at once, because in a real raised letter it would be impossible for us to see both its edges at one and the same time. The same remark applies to the top and bottom edges. The "cast" shadow is the shadow which is thrown on to the background by a raised letter through the sun or strong rays of light shining upon it in an oblique direction: this shadow is of course on the opposite side to that upon which the rays of light fall. A graduated thickness is one with its colour of various tints softened into each other in order to represent more vividly the various degrees of light or the sun's rays as they fall on different portions of the thickness; these may be divided into the high light, the middle or secondary light, and the deepest shadow. A graduated thickness is often put in, however, for mere ornamental effect and showy colouring. The "face" of a letter is its front portion, which is generally painted to appear in the highest light, sunken letters excepted. The explanation of these terms will be better understood on referring to Fig. 66, where A is the face of the letter, B B the thickness or blocking, and C C the cast shadow, or, as it is termed in some parts, the back shadow.

Fig. 68.—Letter with Thickness and Cast Shadow both on same side.

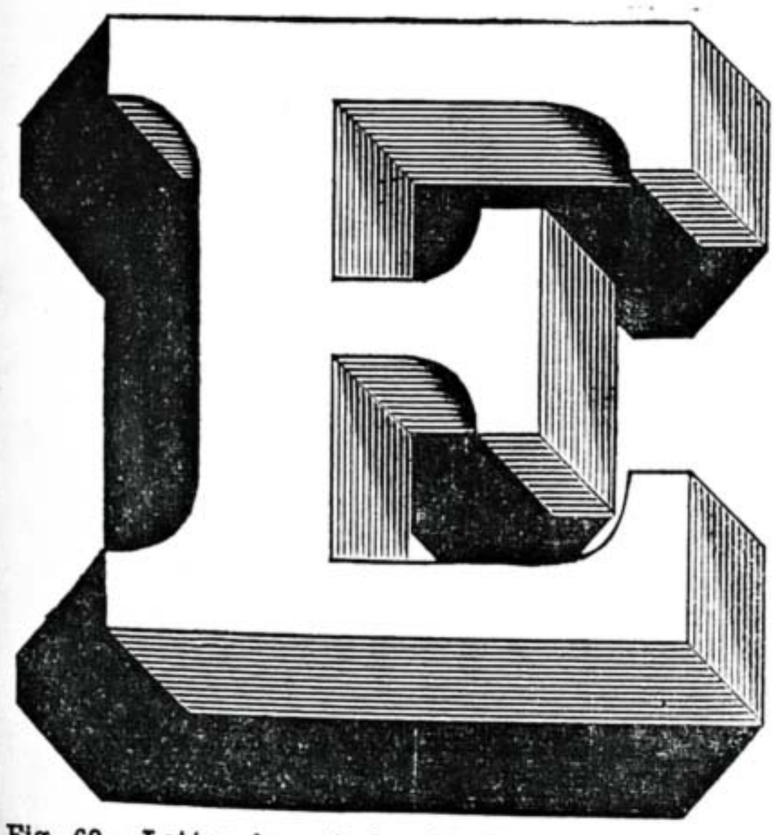

Fig. 69.—Letter invested with Thickness underneath and towards Light. Cast Shadow on opposite side.

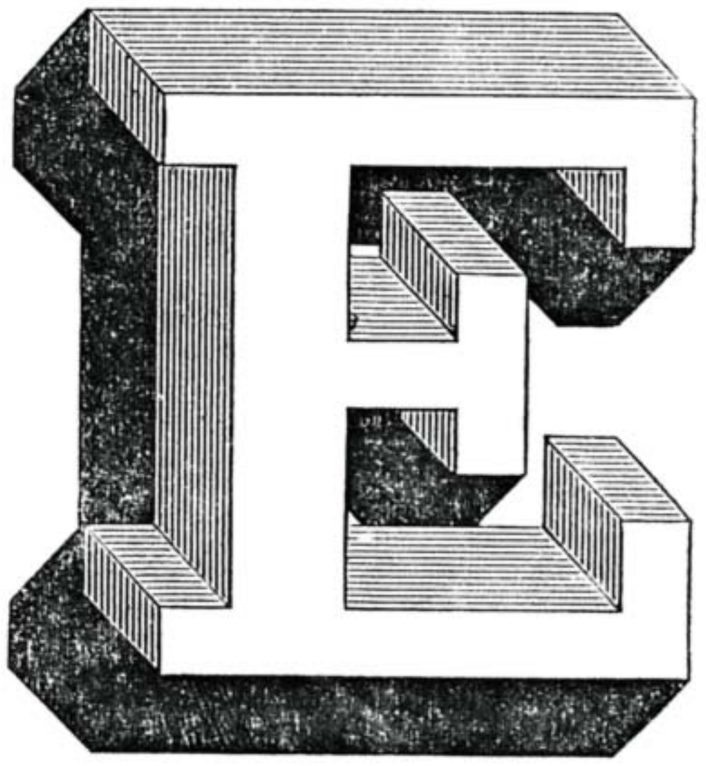

Fig. 70.—Letter with Thickness above and partly towards Light and partly against. Cast Shadow on opposite side.

Fig. 71.—Letters with Thickness against Light and without Perspective Lines.

Although no sign or inscription nowadays would be considered to possess any artistic merit unless the writing were executed in blocked letters, this system of blocking is of comparatively recent introduction: in fact, about the year 1840 it was only then just coming into vogue, but soon became immensely popular, and was considered to be a vast improvement on the "flat" lettering of the old style, and which we only now see on the commonest of work. In order to impress upon the mind of the novice the real meaning of these imitation raised letters, or, I should say, the effect or illusion they are intended to convey to the eye of the spectator, I may say that "blocking" was introduced by the sign-writing profession to imitate the raised cut-out letters in wood which I have previously spoken of, and which, no doubt, did the sign-writing profession at that date

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considerable injury by sudden and unexpected competition. A technical writer of the period indicated alludes to this subject in words which have still greater force and truth than they had formerly; he remarks: "The projecting letters, formed of wood or metal, have of late become so fashionable that the writers on shop fronts and signboards have had recourse to imitating them, and have produced letters *in such bold relief, that they look more real and much better than their wooden rivals.*" The italics are mine.

In "blocking-up," each letter must have its thickness outline in its own perspective, but the perspective must be at the same angle in each letter, say 45°, as being the angle usually adopted. For plain work, the colour of the thickness is usually darker than the ground colour, and also the colour used for the face or body of the letter, but there are plenty of exceptions even in the simple form of blocked letter, some of which are in very bad taste as regards colour. But when we go in for light and shade, then we must decide upon which side of the letter the light is to strike; if the thickness is away from the source of light, its colour will be darker in shade than both the face of the letter and the ground colour, but if it confronts the light, it will be lighter than the ground colour, but darker or of a more retiring colour than the face colour of the letter (see Figs. 68, 69, 70, and 71).

It must be remembered that writing on a shop front or on a signboard is generally looked at from below, so that it is a general rule to invest the bottom end of letters with a thickness, and not the top (Fig. 69). To see a letter with the thickness at the top and above its arms, as in Fig. 70, we must, if the letter be a real projecting one, stand above it and look down on it, but nevertheless, this lettering is often done even when it stands above the point of sight, and out of all true perspective. There is so much latitude allowed in sign-writing, that this anomaly is permitted to pass unchallenged, so that we may thereby obtain a somewhat picturesque effect. I can vouch for the example here given being perfectly correct, as it is a letter formed by one of the most successful writers this country has as yet seen. It is also permissible for one to do his thickness on straight lines instead of in perspective. In this system we have the whole of the work inside the two horizontal lines which contain the body of the letters, and there is not a single perspective line in any letter, yet they certainly have the appearance of projection, as will be seen on looking at Fig. 71. In a graduated thickness, the various tints or colours must not be blended into each other by guesswork; the principle of light and shade must be carefully thought out, and the science of optics studied before any successful result can be arrived at. In looking at some of the best specimens of sign-writing which we come across in the principal streets of some of our large towns, one cannot help being struck with the taste and ingenious talent displayed in the beautifully blended and coloured thicknesses which play such an important part in adding a positive air of grandeur to the work.

It is really wonderful how effectually we can imitate, upon a flat surface, a real raised letter of any description, or of whatever material, whether it be wood, stone, metal, or marble. To ensure success, we have only to be correct in drawing, colouring, and shading; in fact, the drawing must be true, the colouring bold and effective without being gaudy, and the shading and gradation appropriate to the whole, which gives to the subject an appearance of what it is not in reality. I can only add that the most beautiful softened thicknesses are only obtained with slow drying colours, and the judicious use of the blender. Thicknesses may, however, be of any colour, bright or otherwise, according to the scheme of colouring employed by the operator.

I must next turn to shadows; and here I may say at once that however bright in colour the body and thickness may be, if a cast shadow is added it must be quiet in tone, being, in fact, a mere glaze on the ground colour to make such colour darker where the shadow falls. It must not consist of a primary or secondary opaque colour unless the author of such work wishes to be accused of bad taste, and of being a bad colourist. The siennas, umbers, Vandyke brown, and asphaltum are good glazing colours for rendering cast shadows. Letters may be shadowed either on the same side as the thickness or on the opposite side; the latter, I think, will be the system generally adopted, and in this case the thickness receives the rays of light, and is therefore painted in a brighter colour than it otherwise would be, were it represented as in the shade. It is best, perhaps, if it is painted the same colour as that used for the face of the letter, but in a somewhat darker shade. When a thickness faces the source of light it is frequently put in with two or three gradations of tint or tone, the lightest being where the edge of the letter catches the most light, and the darkest in the underneath portions of the arms and bottom end of the letter; in fact, the bottom of a letter always gives better effect to the whole structure when it is painted in a darker shade, as this portion of a projecting letter must necessarily be in the deepest shadow. Of course, the bottom portion of all letters throws a cast shadow, and where these are inserted they follow beneath the thickness, so that the shadow always touches certain portions of such thickness, whether it is on the opposite side, or *vice versâ*. With a letter that has its cast shadow and its thickness both on one side, and against the source of light, the latter is naturally darker than the face of the letter, and the shadow is preferably of a shade not far removed from black. I have frequently alluded to the source of light in this chapter as being the guiding star upon which rests the correct colouring and shading of a letter. I suppose I need hardly say that this light can hardly be anything else than imaginary, in the mind of the writer, when carrying out work of this class; I am, of course, alluding to work in the open air, where the sun, that lights all things, good or bad, is constantly on the move. It would thus be impossible for the workman to so arrange his shadows that they may always be thrown in an opposite direction to that in which the sun is shining, or the light the brightest, because, if even correct in the morning, it would not be so in the afternoon. Most readers may say, every simpleton is aware of these simple facts, but I am writing more particularly for the younger generation, and boys are not apt, overflowing as they are with animal spirits and bumps of mischief, to give even these simple matters a thought. Once bring anything to their notice, however, and set them thinking, and clever lads will work the problem out for themselves; but I am digressing.

The best arrangement we can make, therefore, is to consult the position in which the sign is situated, notice from which direction the light is strongest during the best part of the day, and adapt the light and shade of our work so as to conform with nature, as far as it can, in a pleasing and truthful manner.

There are many specimens of the sign-writer's art to be seen abroad, which have been treated in a purely conventional manner: for instance, one may often see letters possessing a cast shadow, but without any blocking or thickness. The question arises, what is there to throw this shadow, considering that the letters appear to rest quite flat upon the surface; of course the only way out of the difficulty—if such it is—is to stretch the imagination and assume that they *do* project, and certainly by clever and tricky shading they may be given that appearance in some slight degree. After all, the sign-writer is a sort of "free lance," and even in blockless letters with a cast shadow, no very great harm is done if the work is handled judiciously.

Some styles of alphabets of the modern ornamental and mediæval design have the face of the letters shaded: this consists of sharp clear markings or linings. In some alphabets the thickness or breadth of these lines is symmetrical throughout, in others it is thickest in the middle, and graduates outwards to the top and bottom of the letter until it assumes a fine hair line. Those letters known as Tuscan are of this description, and when well done, they have a very gorgeous and rich appearance, especially if the letters are gilded. The student will find a complete Tuscan alphabet in any printer's specimen book; and to render the same more useful to him I would advise that in copying it for practice a full alphabet be enlarged to about the size of the large specimen letters given with this chapter, and they will then prove very useful for future guidance. They should be drawn on separate squares of Bristol boards, and kept in a strong home-made envelope or case, and to add to their usefulness, they may be coloured with water colour and gum in various designs, and will thus be handy for showing to customers for selection. I need hardly say this dodge applies to all alphabets, and is a good way of assuring oneself upon giving satisfaction even before commencing the work, yet, I presume, very few professional hands consult or study their customers' wishes in this way. Another alphabet is that known as the Tablet, and here the shading is all done upon the face of the letter, and to look well requires a skilled and decisive hand, besides a thorough knowledge of the art, otherwise the proper effect will not be gained. Those painted letters are supposed to represent cut-out marble or china tablets affixed to the shop facia—articles which are often seen in the reality, and common enough they look. Another style of letter very difficult to paint, and where the whole effect depends upon clever shading, is the sunken or incised letter, which is just the opposite to the Tablet.

If space permit I will try to give an alphabet of this in a later chapter, and will here only point out that the great difficulty in shading these letters is "*not to give a Tablet letter the (reverse) appearance of a sunken or incised letter, nor vice versâ.*" This is very often done, so "forewarned, forearmed," as the old proverb has it. A complete "Tablet" alphabet is given in Fig. 67, and here also should the letters be enlarged in order to learn and judge of the proper effect, and their suitability for various classes of work.

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OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

119.—EATON'S "POSTABLE" FLOWER POT TRIPOD.

THE accompanying illustration will, I think, be sufficient to show that the "Postable" Flower Pot Tripod of Messrs. S. J. Eaton & Co., Inventors and Manufacturers of Specialities, 131, Great Titchfield Street, London, W., is a light and pretty means of introducing plant decoration into corners and other parts of rooms in which it would be otherwise most difficult to get any adornment of this kind. The only thing about it to which I can take exception is its name "postable," which Messrs. Eaton & Co. have clearly invented for the occasion, as well as the speciality itself, and which is applied to it in virtue of its being made collapsible in one form, so that it can be closed up and forwarded by parcel post for 3d. or 4½d., thus rendering it an acceptable and useful present for transmission in this way, and to be readily obtained by anybody who may desire to have one if it does not appear among the stock of the fancy furniture dealer nearest to the residence of him or her who wishes to get it. As it will be readily seen from the engraving, it consists of three bamboos arranged in the form of a tripod, with a larger triangular board inserted between them near the base, and a smaller one at the top, each board serving as a support for a flower pot or ornamental vase. Those that are sold fixed are 44 in. in height, and 15 in. wide at base; the "postable" are 41½ in. high, and 14 in. wide at base. They are sold plain at 1s. 3d. each, or 2s. 3d. per pair; enamelled in dark colours, or stained and varnished, at 2s. each, or 3s. 9d. per pair; enamelled white or in light colours at 2s. 6d. each, or 4s. 9d. per pair. I may suggest that the plain tripods would furnish a little congenial employment to ladies who are fond of "aspinalling," and who might thus bring them into accord with the prevailing tints and colours of the rooms in which they may wish to place them. Slender and pretty in appearance, the tripods are suitable for use in or out of doors, and make admirable stands for pendant and creeping plants above, and geraniums, etc., below. The stand is strong, rigid, and perfectly stable when ballasted with a heavy pot on the bottom board, and at the point where the bamboos cross each other is a ring to which a small coloured lamp or hanging vase may be suspended.

THE EDITOR.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

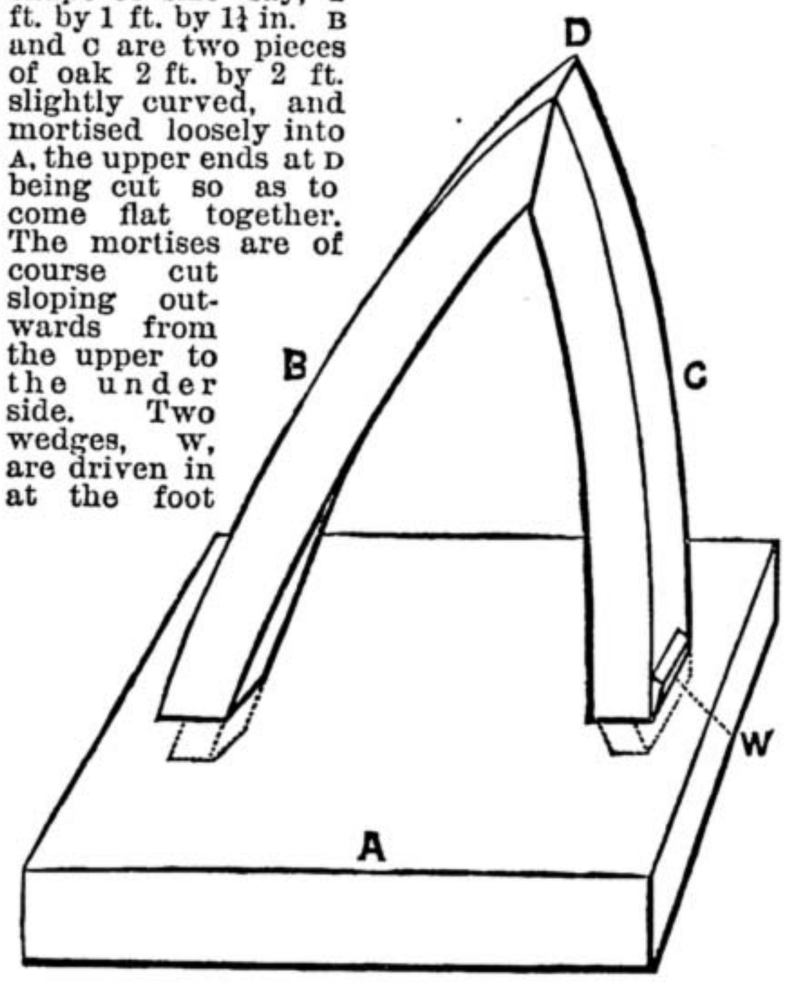
NOTICE TO CORRESPONDENTS.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—LETTERS FROM CORRESPONDENTS.

Fretwork Clamp.—KILDONAN.—The contrivance here submitted is the invention of a friend of mine, a very skilful fret cutter, who in his leisure moments turns out the most beautiful work. It is so simple that any one can make it, and has the advantage of getting rid of the sawdust without any expenditure of breath, or adventitious aid of blower or other complicated arrangement. It is used, of course, by the artist who works with the ordinary bow. A is a heavy block of wood of any shape or size—say, 2 ft. by 1 ft. by 1¼ in. B and C are two pieces of oak 2 ft. by 2 ft. slightly curved, and mortised loosely into A, the upper ends at D being cut so as to come flat together. The mortises are of course cut sloping outwards from the upper to the under side. Two wedges, W, are driven in at the foot of the uprights, thus increasing the gripping force of the jaws at D. Two similar wedges driven in from below serve to decrease the grip, and the tension of the jaws can thus be regulated to suit the convenience of the worker. The faces of the jaws are covered in leather, which keeps the work from slipping. If the wood is left bare it soon gets very slippery, and the work will not be held steady. The *modus operandi* is as follows:—Having drawn the design on the wood, the latter is placed between the jaws, the design towards the worker. It is held upright, and when the holes are bored the saw can also always be held upright, for the tension is sufficient to hold the wood in position. With the help of the left hand, the work can also be turned round, thus relieving the right arm of the fatigue of holding the saw at all sorts of angles. The dust falls down. The apparatus can thus be used in the house, for by spreading a newspaper below to catch the dust and pieces cut out, the cleanly housewife can look on complacently while the "guid man" cuts out some fancy article to beautify and adorn the home.



Fretwork Clamp.

Tools.—H. J. L. J. M. (*Ealing*) writes:—"May I remark that Messrs. Melhuish, of Fetter Lane, E.C., offer facilities to purchasers of tools similar to those offered by the firm mentioned by H. C. on page 542? I have no doubt that Messrs. Buck, or any other tool makers, would give every information and instruction as to the use and capabilities of any tools supplied by them. I am not writing this from any desire to puff the wares of any one firm, but simply from a wish to let every one have his due. As I go in chiefly for chasing and repoussé work, I make the bulk of my tools myself, and am thus far independent of any firm."

Saw Hammering.—J. N. (*Sheffield*) writes in reply to T. O. (*Bootle*):—"I notice a reply from you to T. O. (*Bootle*) (see page 587), who makes an inquiry on the subject of Saw Hammering. I am junior partner in my firm, but am a practical workman. I spend a great portion of my time hammering saws, mostly circulars. I have only been a subscriber to your paper a few weeks, and I did not notice T. O's. (*Bootle*) question. If he will repeat it I shall be pleased to give him any information I can."

Boots and Shoes.—J. R. writes:—"I wish H. G. (*Bishopsgate*) would let me know through your columns how to cut out a pair of men's shoes laced, and a pair of women's laced plain for a light bottom hand-sewed; how to round the insole, the heel about 2 in. high and 2¼ in. broad for men's, and 1¾ in. high and 1¼ in. broad for women's. Should there be two split lifts and one about with the lifts pegged together, or two split first? In all heels should they be slanted in heel seat what way to fit the welts, and dress up after sewn and level; how to make a broad welted boot and set up the stitch—should it be marked with a wheel; how to make a spring heel cork pump bottom, and a pair of slippers turned."

Ink for Posters.—M. D. C. (*Liverpool*) writes in reply to SMILING SMUDGER (*Manchester*) (see page 573):—"I would like to ask him how he calls oil paint ink for posters? From my point there is a vast difference between oil paints and inks. Also how is an amateur to fill up small letters with a pound brush? In reply to H. L. B. (see page 571), I would like to ask him if he ever wrote a poster of printers' ink and paraffin? as he says posters are only written with printers' ink and paraffin or benzoline. It is a nice thing to tell an amateur to use either paraffin or benzoline. Suppose a man bought enough colour to do what he wanted, and he used paraffin, I must inform H. L. B. that his colour would be useless after he had got it mixed. H. L. B., I must say, is a nice party to write an article on poster writing. I would like to ask H. L. B. if he knows how to mix colours for poster writing? If so, what would make a good chocolate or marone that will not fade on being exposed to the sun, also salmon colour, or flesh colour? Also, if he knows anything about poster writing, what would he put in printers' ink to keep it from working stickier, or leaving brush marks on his work. He says he is engaged by the Editor of WORK to write on poster writing. Well, if he is not an amateur I hope he will give us some good information, and I don't care how soon; but from my point he must be an amateur of the worst type, or he would not have mentioned paraffin to dilute printers' ink with. If A. Y. (*Ilkeston*) will send me his private address, I will give him all the information he requires on poster writing and ticket writing, although I am not a professional at ticket writing."

Book on Bookbinding.—B. R. C. (*East Finchley*) writes:—"Will you permit me to inform G. F. S. (*Nottingham*) (see G. C.'s reply to him, No. 36, page 572) that there is a thoroughly good and cheap book on bookbinding—viz., "Bookbinding for Amateurs"—by W. J. E. Crane, published by L. Upcott Gill, 170, Strand, London, price 2s. 6d. It contains full and clear instructions, with numerous helpful illustrations, on each process in the art from start to finish; together with descriptions and prices of the various tools and materials required, and the names and addresses of dealers in the same. Allow me to add that I am in no way interested in the sale of this or any other book, but write solely in the hope of giving a useful hint to a fellow reader of WORK."

Lathe Bits and Drills.—J. H. N. (*Malvern Wells*) writes:—"Seeing some forms of bits and drills for the lathe by OLLA PODRIDA, on page 321 of No. 21 of WORK, I could not resist sending you a suggestion for Fig. 7, an enlarging drill, for which I hope you will excuse me taking the liberty. The plan is, instead of having the wood on sides of drill, to cast in sand a plug of zinc, which is within the means of every one, rather larger than drill, to allow for turning down; then bisect plug down the middle, and cut down with a hack-saw; then fix on drill same way as shown in Fig. 7. The reason I propose a zinc plug is because it will wear better than wood, and not be so likely to be affected by the scrapings or chips cut by the drill."

English and American Tools.—WALSALL writes:—"I should like, through the pages of WORK, to call the attention of my fellow-readers to the price list issued by Mr. Lunt, 297, Hackney Road, London, E., which he will forward to any part of the United Kingdom on receipt of one penny stamp. I have one before me while I write this, and I can assure my fellow-workmen that it is the best list I have been able to procure, and I believe his price will compete with any other firm in the country. The list, which is illustrated, contains eighty pages of the best and most improved tools in the market, and tools suitable for almost every trade that is known. Also a large assortment of cutlery, etc. I feel sure my fellow-readers will not regret sending for Mr. Lunt's list. I myself have found tools in his list that I have wanted for several years, and could not obtain them, not knowing where to apply for them, and I have no doubt many others experience the same difficulty."

A Metal Worker's Complaint.—W. G. (*Gateshead-on-Tyne*) writes:—"In your issue of September 28th, on page 437, there is an article on Metal Spinning by F. Durrance, which I eagerly read, and looked forward for the next issue, as at the end of the article he says 'in our next we will try and have something more difficult,' but as yet I have not come across anything on the above subject."—[These papers will be continued as soon as possible. W. G. will readily understand, however, that contributors to WORK are practical men, who cannot always find leisure to turn from their work and to write. Moreover, other contributors than W. G. want

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their subjects considered, so that it becomes difficult to give weekly sequence to any one subject. All that can be promised is that all subjects commenced in Volume I. of WORK will be completed within that volume.]

Cuts and Bruises.—MECHANIC (*Rugby*) writes:—"Being a subscriber to your valuable paper, WORK, from its birth, and having read the correspondence from the writer in 'Means, Modes, and Methods.' and the replies, to and from, by MEDICUS and the writer (whose name does not appear), in reference to remedy for severe cuts and treatment of bruises (WORK, No. 26, page 411, and No. 35, page 555), I think, perhaps, you will not be against a few remarks thereon, having passed over twenty-six years in private and public engineering works of one sort or other, wherein I have seen, and in many cases attended upon, the injured parties. Prior to anything out of the way in 'Shop,' I would beg to say that when I was a boy of fifteen years old, my father, who was a brushmaker, had the misfortune to cut off his little finger on the left hand (about the centre of the middle joint) with the bench knife. This he picked up off the block, placed it where it came from, and walked to a chemist's shop, where it was strapped on again. This finger adhered to its old place, but it would not work with the others after. I know it had to be opened or shut by the aid of the other hand, but I could not now say which, and I have heard my father say many times that he had better have lost it at first, as it was often in the way. Still, I hope this goes to prove that parts of limbs will take root in their old places. As regards cuts and bruises I have seen many, from simple ones on the fingers to human bodies right through; and from nips from pincers, or cracks from hammers, to men hurled yards by blows from machinery. Of course neither of the latter cases would be likely to require the aids as prescribed by your writer in 'Means, Modes, and Methods,' as in such cases generally the sufferers rarely survive many hours, sometimes minutes, but for ordinary use I can assure MEDICUS that I have used gallons of turpentine for bruises, also for cuts. I never used leeches, but have seen them used; but for hammered finger or thumb nails, I have scraped and cut the middle of the nails away to release the blood underneath, which is equal to leeches sucking it out, I should suppose; and I know from experience which thumb or finger will get well first, the one cut, or the one left with the blood to rot under the nail. At sixteen years of age I had the inside flesh of my left-hand thumb torn off to the bone, from the nail end to the first bend. This was done at play. I went home, and asked my mother for a needle and white cotton, with which I put quite twenty stitches round the piece; after which I bandaged it up in old linen, and steeped the thumb end in Friar's balsam, and the thumb is as good to-day as when I was born with it; and I do not hesitate to say that good turpentine would have done the work equally as well. I have also used it in scores of cases of bruised flesh, having been ambulance man in one works over fifteen years. I am not now connected with any firm; but in addition to turpentine would recommend Friar's balsam, and a new article termed vaseline, and sold in boxes from one penny upwards. I have found the latter article very good for cuts and bruises; in fact, it heals and eases the pain like magic. I could give other cases and cures, but hope the foregoing will convince MEDICUS that he is not quite correct, and should space be allowed me at a future date I shall be pleased to give several tips upon treatment of injury to the limbs."

An Easily-Made Fret Machine.—EAST WINDOW (*Southport*) writes:—"Would W. R. S. (see page 332) explain what he means when he says that the throw of the machine will be double the distance from centre to centre of the piece marked C? What centre does he mean? and how does he arrive at the length of the piece marked C? for if it was not the proper length, I think there would be some difficulty in the working of the machine. I am sorry to trouble W. R. S., but I have never had anything to do with treadles or machines, so am ignorant of their working. I am much obliged to W. R. S. for his plain direction in the other parts of the machine, which has long been a desideratum."

A Simple Incubator.—A. T. B. (*Walthamstow*) writes:—"Will W. L. (see page 557) kindly state what kind of lamp was used, also the degree of heat employed, and the means of ascertaining it, as no thermometer is mentioned?"

Hints to our Staff.—GNIMELF (*Dublin*) writes:—"Seeing in your issue of WORK for November 9, No. 31, a letter from W. B. (*Liverpool*) referring to writers for WORK shortening their descriptions, I beg to say that I quite agree with him. For instance, I wanted to make a camera. When I got the number it was in I was delighted, but after reading it I had quite to give up the idea of making one, as I could not understand it enough. I don't want to find fault with WORK, for I consider it the best paper I ever subscribed to, but if the writers would go into small details it would be much better. The article on Folding Stove is very vague."

A Simple Incubator.—A. R. (*Manchester*) writes:—"Will J. T. R. (see page 654) kindly answer through 'Shop' how and where does he use the lamp, and what kind? What position the drawer is, and how it opens if it has no bottom with eggs in? Has the damper to be bored through into the drawer, and what does he use for a damper?"

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Book Edge Cutting.—F. H. (*Walsall*).—There will shortly be published in these pages a series of articles on bookbinding proper, from which I hope you will learn all about "cutting edges," and not only this but everything in connection with the art. You are quite right about the plough. There is such an article, and it is used in conjunction with the press—the lying press as it is technically called. In the meantime I will give you instructions for making a plough, which I trust will be sufficiently plain. If you know anything about wood-working, I don't think it will be a very difficult task to execute. Fig. 1 shows the complete tool looking from above. Fig. 2 is a side view. The correct

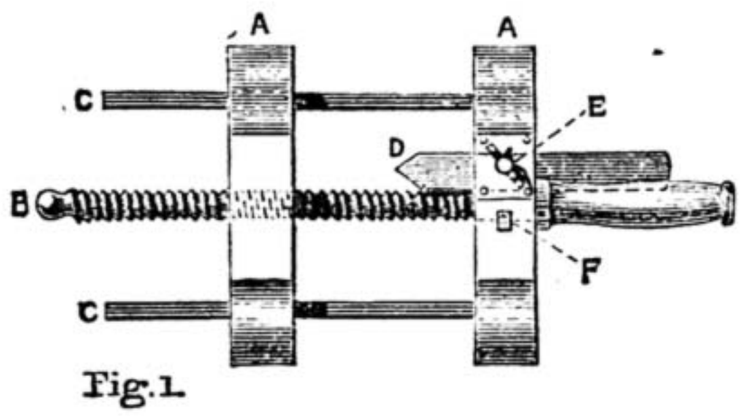

Fig. 1.

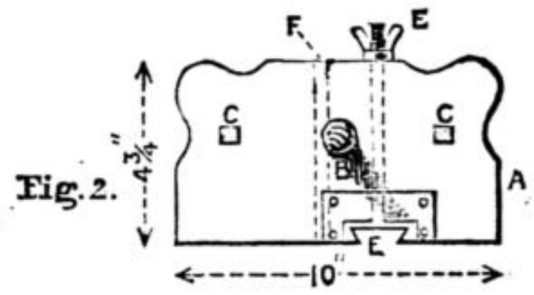

Fig. 2.

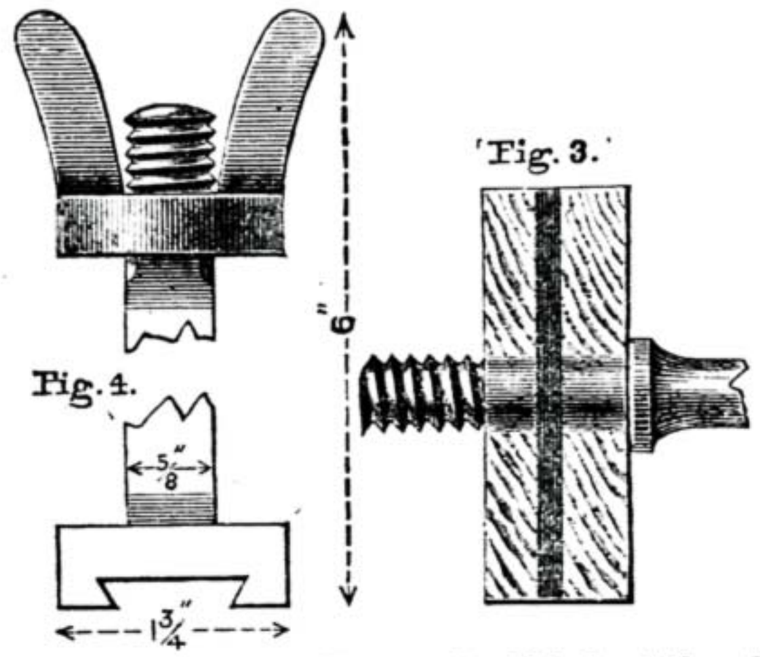

Fig. 4.

Fig. 3.

Book Edge Cutting. Fig. 1.—Bookbinders' Plough looking from above. Fig. 2.—Side View. Fig. 3.—Detail of Wooden Screw, B. Fig. 4.—Enlarged View of Knife Bolt

A, A, Sides; B, Wooden screw; C, C, Square rods to act as stays; D, Steel knife; E, Knife bolt; F, Pin to keep screw in position.

sizes are given, and the letters in both figures refer to the same parts. The wood to be used should be well-seasoned beech, although for your purpose a commoner kind may be substituted, as I believe beech is difficult to procure. The two sides are made the same shape, and it is not necessary to adhere closely to the shape given in the diagram. They should be made of 1¾-in. stuff, 10 in. by 4¾ in., and three holes in each—two square holes at equal distances from the ends, and a round hole in the centre; the hole in the left-hand side will require to be tapped to take the screw. The screw may be about 22 in. long, including the handle. A groove will need to be cut ¼ in. from shoulder (Fig. 3) to take a pin to keep it in its place. A square iron pin with a screw at the top, and provided with a wing nut, and a wedge-shaped piece cut out at the bottom to receive the knife, is passed up through the right-hand side (Fig. 4). On the top of the same side is an iron plate to prevent the wing nut from sinking into the wood; at the bottom also are two iron plates, against which the knife presses when the nut is tightened. The knife itself is a wedge-shaped piece of steel ground to a point at one end. To perform the operation of cutting with the plough, the book is screwed up tightly in the press, allowing the part to be cut off to be above the cheeks of the press. The plough is driven to and from the body; the screw is turned gradually until the cutting is completed. The left-hand side of the plough runs between two strips of wood screwed to the left-hand side of the press, and as the right-hand side is free to move, as the screw is turned the knife is brought over the entire edge. If you succeed in making your plough, and learn to cut books with it, you will not need to be ashamed to show your books to your friends, for edges cut with the plough are more satisfactory than those cut by the machine.—G. C.

Sanitary Inspector's Qualifications.—G. S. M. (*Hartlepool*).—The necessary information respecting qualifications, etc., for a sanitary inspector may be obtained by applying to the Secretary of the Sanitary Institute of Great Britain, 74A, Margaret Street, W.—E. S.

Making Fret Saw Machine.—JIG SAW.—I am sorry you are disappointed at this subject not having been treated yet, but everything cannot be treated at once, and there are many subjects of more general interest to the majority of readers. Let me advise you, instead of wasting the long winter nights because you have not a machine, to get one of the little fret saw frames which are worked by the hand, as you are much more likely to accomplish good work with it than with a machine of your own make under the circumstances to which you allude. Though the ambition of many fretcutters is to have a machine, I can assure you that unless it is of the best description a hand frame is better, and that for some work it is, to say the least, superior. Such thick wood cannot be cut with one as with a good machine, nor is it quite so rapid, but otherwise everything that can be done with a machine can be done with a frame. Your desire to make a machine seems to be on account of supposed saving in cost; but if you have to buy materials you would probably find that it would have been cheaper to have bought a machine. Perhaps these remarks will reconcile others who want descriptions of fret machines to absence of papers on the subject. You will find secondhand machines constantly advertised in *The Bazaar*, if you do not care to invest in a new one. It is impossible to answer your questions precisely without fuller particulars and detailed measurements of the parts you already have and intend using up.—D. A.

Watch Repairing.—PIVOT.—Your query has been sent to the proper quarter, and will doubtless soon elicit a reply. The contributor who takes charge of these special questions has been away from home on his annual holiday, and hence the reason that you are kept waiting. I have his promise that all these things shall receive immediate attention on his return. You may be sure that when an answer to a query is long in coming it is delayed for a good reason."

Matching Plane.—C. H. L.—If you will send me drawings and description of your matching plane, I shall be very pleased to look at them with the view to publish them. It would also be useful if you could let me have a look at your plane. It shall be quickly returned to you after I have examined and tested it.

Gilding and Mount Cutting.—J. A. McL. (*Glasgow*).—An article on mount cutting is in preparation. Gilding in all its branches will also be taken in hand shortly by a practical man.

Photo-Zinco Process.—PRINTER (*Edinburgh*).—The processes employed to obtain zinc relief blocks are varied, and some of them are secrets religiously kept by their proprietors. There are, however, two methods which any one is at liberty to experiment upon, if means and capabilities are agreeable, and I will briefly describe them. First, a drawing upon lithographic stone may be transferred upon a polished zinc plate, and afterwards etched by immersion in a bath of acid; secondly, a drawing or a print to be reproduced, if its detail be expressed by lines or dots, may be photographically rendered upon zinc which has been sensitised with bichromate coating (albumen or gelatine as the case may be), but the operator must use a rectilinear lens. The zinc is then treated thus:—A roller charged with litho ink is passed entirely over the surface, leaving behind a layer of ink, the thinness of which will be determined by experience only. The picture is developed by placing the plate in a vessel containing sufficient water to cover it, and while immersed gently clearing away with a dabber of cotton wool the coating which has not been affected by light. The plate is then fanned dry, and asphaltum powder is brushed over it, so as to adhere to all parts of the work; gently warming the plate, now causes the ink and asphaltum to unite. The biting away or etching in either case is managed somewhat after this fashion. The zinc plate with the subject upon it is covered with a protective agent capable of resisting the action of acid, and protecting the places where it is desirable, such as the back, edges, and large whites. The plate is then immersed in an acid—that is, a solvent of zinc, diluted, and a see-saw motion is given to the trough in which the bath is prepared. This rocking enables the acid to do its work more thoroughly than were it allowed to corrode the zinc gradually. This description is necessarily rough, but no doubt the book on "Zincography," published by Wyman, Great Queen Street, Lincoln's Inn Fields, will give information at greater length.—J. H. M.

Enlarging Camera.—MERVEILLEUX (*Peckham*).—Your sketch of the front of enlarging camera is quite correct, and shows that you have thoroughly grasped the details of construction. The inner box is movable, and slides out and in, for this reason, that the greater the size to which you enlarge the nearer must be the lens to the negative, while for small enlargements the distance has to be increased. If the box, therefore, were a fixture, as you seem to suppose, you could only enlarge to one given size, while, by moving it, you can make your picture any size up to 12¼ in. by 10½ in. The lens you have will do very well for the purpose of enlarging, but you are in error in supposing it has only one "glass;" it has in reality two, which are cemented together, and so appear as one. As to your query as to the length of the baseboard, the fact that you only use quarter-plate negatives

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will not affect its length, as that is regulated by the size of the enlargement, not the negative, so that if you wish to have your pictures the full size that the camera is capable of making, the baseboard must be kept to the size given. In No. 23 of WORK, at page 360, you will find a method given for the making of a camera bellows of a tapered form. You should not use leather, as it is very expensive in such a large size as you require; stout brown paper with black calico well glued down on each side makes a very good bellows, and possesses the merit of being easier to manipulate. If you decide on making a square bellows, you had better make a rough box the size of the inside of the folds, and work them over it, letting the glue dry thoroughly, and then removing the box, which is simply to serve as a block to work upon while folding. Should you meet with any other difficulties I will be glad to smooth them away for you if in my power, and as I reside near your locality could give you a call, and a verbal explanation, if you communicate with me through the Editor.—G. LE B.

Batteries. — H. L. D. (*Heaton Norris*). — In answer to our querist, I am afraid he is rather hazy about electricity and its terms. I suppose by what he terms penetrating power, he means the current in ampères. This depends upon the resistance of the cells and the E.M.F. (electro-motive force). A small bichromate cell such as he mentions has an E.M.F. of 2·0 volts and 0·8 ohm internal resistance, so that with 50 such cells in series he would have by Ohm's law:—

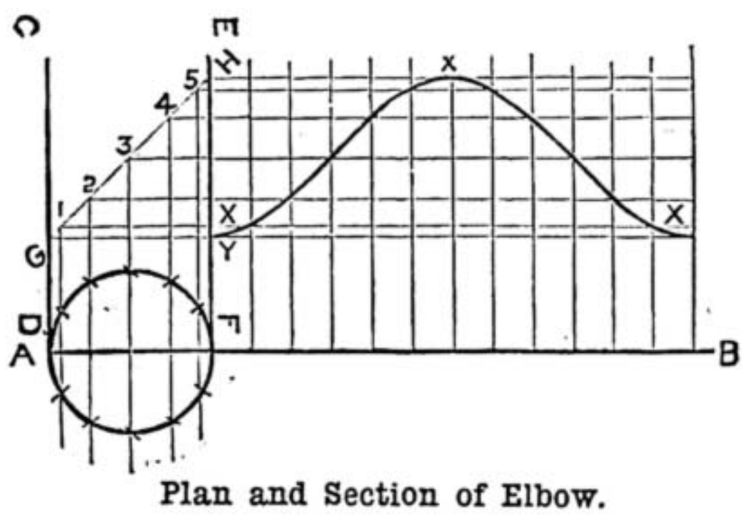
$$\frac{2{\cdot}0\times 50}{0{\cdot}8\times 50}=\frac{100}{40}=2{\cdot}5 \text{ ampères.}$$

To measure this resistance he would need a resistance box and differential galvanometer, which I fancy our querist is not provided with; and another thing, even if he were, I very much question from the tone of his query whether he has the essential electrical knowledge that is required for all electrical measurements. If he has, however, the instruments, and thinks he can manage "Ohm's calculations," and likes to write again, I will advise him. Another thing that leads me to suspect our querist's knowledge of batteries lies in the fact of his using the bichromate cell for medical purposes. This is a bad thing from two points of view:—(1) That with the number of cells he has (especially in series) he is using a dangerous current, if using it on the human frame; and (2) the cell only gives a current from three to four hours, when it requires recharging. The cell that is recognised by electricians for medical purposes is the medical Leclanché. This consists of an outer cell of glass or ebonite, containing elements of a zinc plate, and a small carbon block. The zinc is wrapped round with a layer of canvas or flannel; these elements are placed in the cell, and are surrounded with a mixture of equal parts of small broken carbon and manganese. This is tightly packed in the cell, and thoroughly saturated with a strong solution of sal-ammoniac. This cell will give a current for five minutes, and then will require a little rest (to revive itself) and it is again ready for use. It is this cell that is always used for medical purposes, and so I should certainly advise our querist to change his bichromate cells for these. These cells are good for four or six months' work, and so it will clearly be noticed that it is a rather large step in advance of his now costly cells. Any further information I shall be very pleased to give.—F. W. M.

Paint for Glass Writing.—F. P. (*Bolton*).—Thanks for your letter; you may rest assured that our Editor is determined to make WORK the technical paper for all workers. "Rome wasn't built in a day!" you know. Scene painting will be, doubtless, taken in time; but it is a subject that requires some knowledge of painters' pigments and processes on the part of the student, to attain to any practical success. You are, therefore, advised to thoroughly master the papers on house painting, and these will prepare you for the other subject. We can't have "all paint" at once, you know. As to glass writing:—Mix your pigment or white lead, according to desired colour, with good copal oil varnish. Quick-drying varnish would be too brittle. Ordinary oil paint would take too long to harden right through, and there is a non-absorbent surface to consider. Carriage varnish will do. Keep your pencil free by rinsing in turps occasionally. Back your glass writing with varnish colour made in the same way, and give two thin coats in preference to one thick coat.—F. P.

Books on Photography.—AMATEUR had better purchase Burton's "Modern Photography," or T. C. Hepworth's "Photography for Amateurs" (Cassell and Co.), which will afford him all the information he will require as to the practice of the art; anything else is a matter of experience. With regard to the appliances necessary they are few, and may be thus enumerated:—Camera with dark slide, lens, tripod, developing dishes, measures, washing-pan, magnifier, and focussing cloth, dry plates, and chemicals for developing and fixing, varnish, printing frames, sensitised paper, and toning bath. As to how these are to be used, information will be obtained by carefully reading Burton's work. If AMATEUR gets into any difficulty after this, if he will communicate his trouble to WORK, I shall be pleased to help him along.—D.

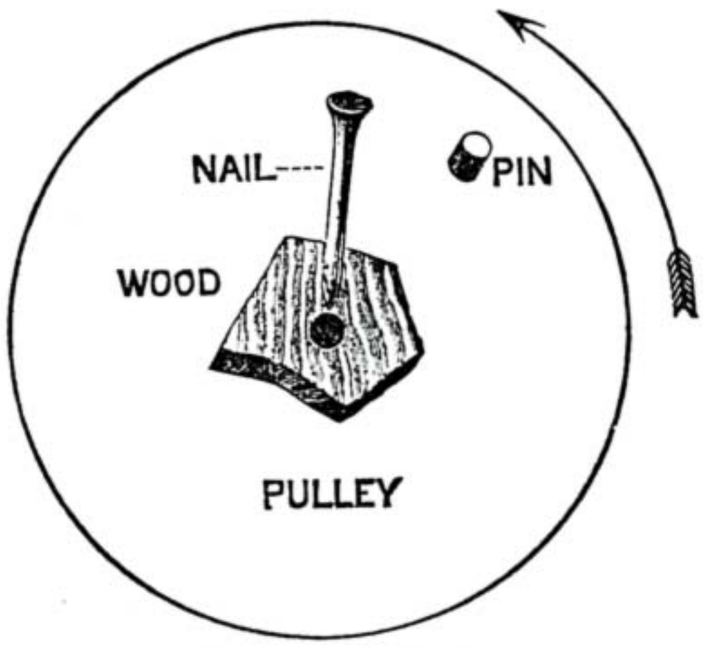
Iron Stove Pipes.—AN IMPROVER (*Arundel*).—To set out elbows in sheet iron, etc., proceed as under:—Take the piece of metal that is to form the pattern, and at the left-hand end of it describe a circle equal to the diameter of the pipe. Have the stuff long enough. Say you are cutting the pattern of a 4-in. elbow ordinary right angle or 90 degrees, cut the stuff 18 in. by 12 in. Having described the circle, draw a straight line, A B, through the centre of it. Next divide the circle into twelve parts; erect the two perpendicular lines, C D and E F, also the lines 1, 2, 3, 4, 5, cutting the divisions of the circle. Then set a bevel to half the angle required—in this case it will be 45 degrees, being half of 90 degrees—and draw the diagonal line, G H. Now along the line, A B, commencing from line, E F, set off the length required for the circumference of the pipe in twelve parts. For 4-in. pipe this will be 12¾. Now draw twelve lines perpendicular to A B. Now



Plan and Section of Elbow.

from each point where the diagonal line, G H, cuts the lines, C, D, E, F, and 1, 2, 3, 4, 5, draw lines parallel with A B. Draw a curved line, X X X, starting from the point Y, and going from corner to corner. This gives the correct pattern; allow ¾ in. each side for seam. Any angle can be set out like this, bearing in mind that the angle, G H F, must be half what you want the finished elbow. I hope this will be plain enough for you to understand. I think you will if you read it carefully and work it out two or three times. There are several other ways of getting these patterns, but I think this is about the best. I shall, however, have something to say about them when I arrive at that part in sheet metal work. To draw pipes in so that one length will fit the other is termed "tucking," and is done as follows:—After you have finished grooving the seam, draw the length of pipe nearly off the mandrel, and taking a thick pane hammer draw the end of the pipe in by lowering the left hand, that is holding the pipe, so that the other end is slightly raised from the tool; work right round the pipe with the hammer, taking care not to get solid blows on the tool, or you will stretch the pipe instead of making it smaller. When you have got round you will have made a kind of groove round the pipe. Now work round and round, gradually coming nearer to the edge, and working the puckers out. Strike with a kind of drawing motion, and finish off smooth with a mallet. Tin spouts, such as beer-can, tea-kettle, etc., are first turned straight, then filled with lead and bent, and the metal run out again. It is not worth your while to do them as they are so cheap, unless of course for any special job.—R. A.

Home-Made Lathe. — A READER (*Newcastle-under-Lyme*).—The wood is not driven by the bush of the cone pulley, but is simply put between the centres of the lathe. If now a screw or nail be driven into the end of the wood near the fixed headstock long enough to engage the pin mentioned in



Home-made Lathe.

your query, you will find that when the pulley is revolved it will bring the pin into contact with the nail or screw, and thus cause the wood to revolve likewise. In practice a carrier is generally employed instead of the nail or screw. In the end view annexed, when the pulley revolves as indicated by the arrow, it will bring the pin into contact with the nail, and cause the wood to revolve.—SELF-HELPER.

Microscope.—B. L. H. (*Glasgow*) has a microscope the power of which he wishes to increase, and asks how it can be done. I may say there are three ways of increasing the power: (1) By increasing the length of the power tube—this mode I should not advise; (2) by increasing the power of the eye piece — there are three powers often made and marked A, B, C; and (3) by changing the object glass. B. L. H. has a triplet which magnifies according to his measurement, 1—80, 2—100, 3—135, and he wishes to know, can the power be raised to 400 diameter? Certainly with the requisite O.G.; what that power should be it is impossible for me to say, as I do not know the magnifying power of the eye piece. What I would recommend B. L. H. to do is to send the microscope to an optician, and ask the cost. Mr. Lancaster, of Birmingham, would give him the information, I have no doubt. But before doing so, I would like to point out an important question or two. B. L. H. speaks of his instrument as a small microscope. It is for him to consider whether the other parts of the instrument than the power tube are good enough to spend much money on. Many amateurs forget that really the most important parts of a microscope are the stand and focussing arrangement; if these are all right, then higher powers can be added when one has the money. But to spend some pounds on a high power O.G. on a stand which is not perfectly steady, or where the focussing arrangement is not perfectly smooth and free from tremor, is simply a waste of money. Before I could advise any one to purchase high powers I should want to know the make of the instrument, as it seems to me that the powers attached are as high as could be used with advantage. B. L. H. asks, would an inch O.G. be suitable? Here we are on surer ground, and can answer in the affirmative. As a rule high powers are of little use to beginners, simply because they show but a small portion of an object at a time, whilst a low power, as an inch or 2 in., will take in a considerable field of view. But here, again, I cannot tell how much an inch would magnify, as that depends on the eye piece. Shall be glad to give further information, if possible, through "Shop."—O. B.

Lantern Slides.—G. B. says he has a lantern but no slides, and he wishes to know the cheapest way to procure some. By this and the statement made that he has some knowledge of photography, I presume he proposes to make his own. Beautiful and effective slides can be produced by copying—photographically—good wood engravings. As there are so many beautifully illustrated books and magazines now, there is no want of subjects. G. B. also asks where to get transfers for slides. I may say Mr. Lancaster, Optician, Birmingham, supplies the very thing. Personally, I can say nothing of them, as I have not seen them, but from what I know of Mr. L.—and I have had dealings with him many times—I am confident one would get their money's worth from him. The next and best plan of all is to paint slides. If there is a desire for the subject to be discussed, I shall, at the Editor's request, prepare a series of lessons on slide painting in oils and water.—O. B.

Bright Parts of Tricycles.—F. W. R. (*Harling*).—Coat them with some transparent enamel, of which several equally good kinds are sold for the purpose of preserving bright steel from rust.—D. A.

Twine Makers.—A. S. C. Y.—I am quite unfamiliar with the thing you ask for—viz., "a Cromer twin spinner," and I cannot find any one who knows what it is. At a venture I reply to your question. It may possibly refer to Macramé twine, of which you wish to know the name of a manufacturer. Write to Boardman Bros., Sharp Street Mills, Rochdale Road, Manchester; but if you only want a small quantity get it through some dealer in your own locality. If, instead of telling us you are "a constant reader of WORK," you had put your address, I might have been able to give you the name of some one in your own neighbourhood.—D. A.

Music Turnover.—EUGENE (*Castlejohn*).—There are several contrivances for turning over the leaves of music while playing, but I believe none of them have met with general acceptance. They are more of the nature of "fads" than of practical utility. The best forms are patented, so that you would be precluded from making and using. You may make a simple one with pieces of wire loosely hung at the top. Put a wire between the leaves you wish to turn over, the wire being sufficiently long to be caught at the lower end. With this or any other arrangement for the same purpose, you will be able to turn the music over nearly as quickly and conveniently as by the ordinary plan. To emboss headings to note paper, etc., you require a steel die, or rather, two of them, one having raised letters, etc., and the other sunk. These are fitted to a convenient press actuated by lever. The paper is put in between the dies, which are forced together, and the embossed imprint is formed. This, I think, will be intelligible to you without a sketch, and show you that the work, so far as the formation of the dies is concerned, is beyond your powers.—D. A.

Battery for Electric Light.—W. D. (*Blackfriars*).—The Bunsen battery is the strongest and most lasting for the electric light, but it gives a good deal of trouble in setting up and cleaning, and it gives off noxious nitrous fumes whilst working. If the same porous cells are charged with a solution of chromic acid instead of nitric acid, we get the next best battery, stronger at first but not so lasting in action. The whole subject of electric lighting in a small way is being dealt with in a series of articles now preparing for WORK.—G. E. B.

Electric Light for Photographic Dark Room.—F. D.—Respecting a former reply on this subject on page 445—both zinc plates and carbon plates should be of the size therein mentioned. The battery does not give off offensive fumes if

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charged with the solution of chromic acid. Of course, there is a certain acid odour about the apparatus, but that is not considered objectionable. Am glad you find WORK the paper you wanted.—G. E. B.

Bicycle Purchasing.—A WELL-WISHER (*Forest Hill*).—A WELL-WISHER would certainly find it cheaper to buy an ordinary bicycle finished ready for using, than to buy the parts ready for putting together. He gives no indication of the quality of the machine he wants. New ordinaries can be had from £4 10s. up to about £18. If he wants a cheap machine, and at the same time good value, he will get it from L. Deney, Berwick, from £4 10s. to £10. If he wants a tip-top, let him apply to Rudge, Singer, Bayliss and Thomas, or the Humber people, at prices from £15 to £18. There is no *best* maker; there are many of them, and to buy the parts finished of one of the best makers, fit them together, then get the machine enamelled and plated, would be costly, unsatisfactory, and altogether a mistake.—A. S.

Bending Wood Lawn-Tennis Racquets.—AMATEUR CARPENTER.—The wood used is English ash, and is boiled in a long tube or pipe for an hour and a half, when it is sufficiently pliable to be bent round a mould shaped like the inside of a racquet.—C. T. S.

Slate Mantelpiece.—OLD TIPTONIAN (*Tipton*).—The proper way, of course, is to enamel your mantelpiece, which, without proper appliances, you could not manage yourself. Failing this, you might certainly try the effect of one of the enamel paints; although it is not clear whether you simply want to touch up the mantelpiece here and there, or to go all over it.—D. A.

Music Canterbury.—A. T. F. (*Dover*).—Two novel and tasteful designs for a music canterbury or whatnot will shortly appear in WORK.

Knife Cleaner.—A. D. (*Wath-on-Dearne*).—Buff leather will be best, but almost any that is not too hard will do. Ordinary good sheet indiarubber. As for the rest of your suggestions, "Yes" will be sufficient answer. I am afraid you will find the job you contemplate is rather a difficult one.—D. A.

Worm in Furniture, etc.—P. H. C. (*Croydon*).—When once wood is attacked by parasites it is extremely difficult, if not impossible, to effect a radical cure. You may stop further ravages for a time, but sooner or later the "worms" will appear again in all probability. Benzoline is the best thing to use. Wash this freely into the infested parts. It will destroy existing worms. Of course you must not use the benzoline near a fire, as the vapour is exceedingly inflammable. To gild picture frames use the ordinary leaf gold as prepared for gilders' purposes. If an imitation will do use Dutch metal, which is got up and sold in similar form, or else a bronze powder mixed with varnish. Quite impossible to answer questions in our next issue after their receipt.—D. A.

Glaze.—F. W. R. (*Harling*).—Glaze is easily made by dissolving gum benzoin in methylated spirits. Proportions may vary, but a good general rule is to mix equal quantities—*i.e.*, half fill a bottle with the crushed benzoin, and fill up with spirit. You will require to strain the mixture before using. It is used to finish French polished wood instead of "spiriting off," to which it cannot be compared for durability of surface. By glazing, the polish or gloss is got quickly and without difficulty, but it is not to be compared with the legitimate method of finishing. It would be useless for you to apply glaze to bare wood, or over a varnished surface.—D. A.

Reviving Morocco.—F. W. R. (*Harling*).—Morocco seats may be freshened up by going over them lightly with a little thin French polish. Do not saturate the leather, and unless you are careful you will do more harm than good. Worn parts must be touched up with a little colour. White of egg is sometimes recommended as a reviver. It may be more convenient for you, but I have never used it personally.—D. A.

Stain for Light Wood.—F. W. R. (*Harling*).—Bismarck brown, mixed with warm water, makes a mahogany stain. A decoction of logwood chips will do the same. The nearest approach to a good rich mahogany, and not offensively red in colour, may be got by using a little weak walnut stain, composed of Vandyke brown, liquid ammonia and water to colour the wood, and then polishing it in the usual manner with red polish. This you can make yourself with ordinary French polish and a little Bismarck brown.—D. A.

Arms of Towns.—F. C. S. W. (*Birmingham*).—In Burke's "General Armoury" are verbal blazons of the arms of British towns and bodies corporate. The tinctures are, of course, given, so that any one who understands heraldic terms and heraldic painting will have in it all that he requires. The book may be found in most good libraries, or any bookseller will know and can get it. With any work containing coloured plates of the arms of all our towns we are not acquainted. A work of that nature, if produced with such care and exactness as to be of authority, must, from its nature, be very expensive.—M. M.

Outlines in Perspective.—R. Y. (*Norwich*)—There have been several inventions with the object of drawing correctly outlines in perspective, but we do not know of any which have been thoroughly practical and successful in working. It is beyond our province to compare the merits of one invention with another, having regard to their patent rights. If you give particulars of your invention to several firms you run the risk of having your ideas pirated, and it would be difficult for you to prove that your invention had been stolen. It is unwise to explain matters that have not received any protection. The most satisfactory way would be to search the records of the Patent Office, to ascertain if your idea has been anticipated. The Patent Office Library is open from 10 a.m. to 10 p.m., and is situated at 25, Southampton Buildings, Chancery Lane, London, W.C.—R. and C.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Adjusting a Compound Lathe Rest for Taper Turning.—IRON TURNER (*Bolton*) writes in answer to A READER (see page 382):—"I suppose A READER will have a mark on the base of his rest, to show when it is set right for parallel turning. Now, READER, take a pair of callipers, and get the diameter of the base of your rest, take half that diameter, and you have the radius. Rule—multiply one-half the taper required by the radius of the base of rest, and divide the result by the length of the taper part. Example—a piston rod end requires turning taper for crosshead to fit. Length of taper part, 8 in.; the two diameters, $2\frac{1}{2}$ and 3 in.: supposed radius of base of rest, 6 in. Now, by the above rule, one-half of taper = $\frac{1}{4} \times \frac{6}{1}$ = $\frac{6}{4}$ and $\frac{6}{4}$ divided by 8 = length of taper part = $\frac{6}{4} \times \frac{1}{8}$ = $\frac{6}{32}$ or $\frac{3}{16}$ of an inch distance to move rest. Take up this distance with a pair of compasses, place one compass leg on the mark on your rest for setting it parallel (your rest being set for parallel turning), and mark a faint line with other compass leg on the base of the rest. Move rest round until your centre mark coincides with this line, and your rest will be right for the taper you require, but remember whether by this or any other method, everything must be mathematically correct, otherwise you will not get your taper absolutely correct."

Machine for Current of Air.—J. A. P. (*Accrington*) writes:—"In looking through 'Shop,' I have noticed several replies to BELLOWS (see page 190). The fans sent have been out of shape and proportion in my mind. One with the wings bent the wrong way; and the one in No. 35, page 557, would blow very little, as the pulley on the fan is too big, and the driving wheel too small. It is made left-handed, and the hole in the pipe is not large enough. You cannot force a fan like you can bellows. It wants more play, as you will see by looking at Fig. 1. The pipe being much larger, the

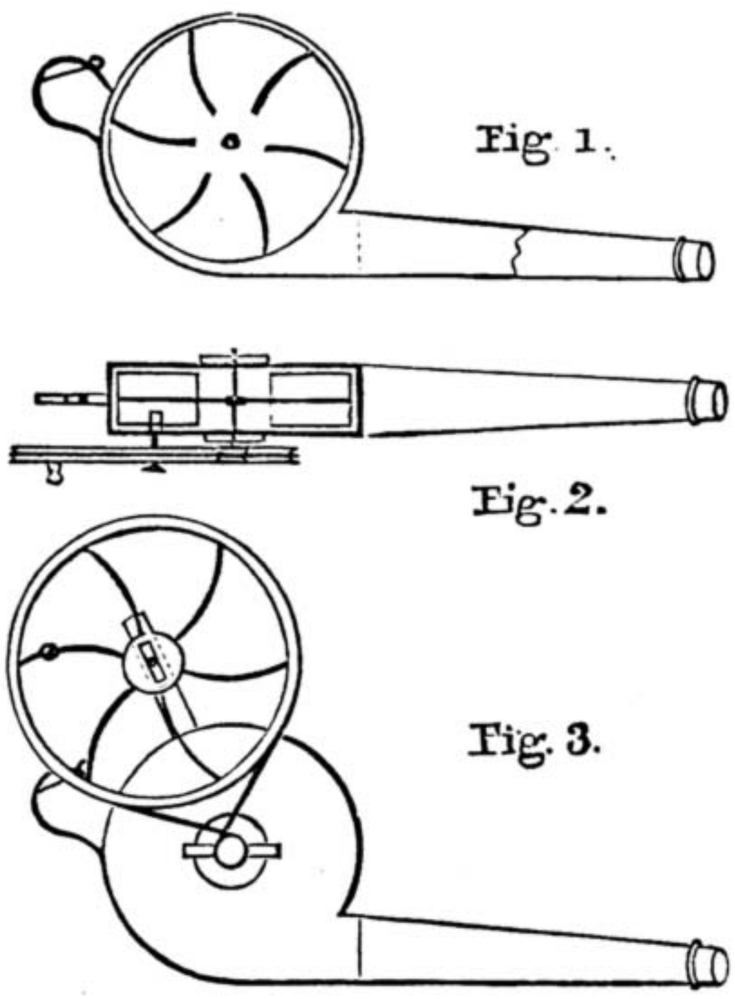

Fig. 1.

Fig. 2.

Fig. 3.

Machine for Current of Air.

spider should not run close to the case all the way round, but as marked in Fig. 1. Now as to making it. Do not use wood, as it dries in more one way than another, and I know cardboard is useless, as both have been tried many a time, and do not pay for the time in making. If they are worth making, make them well. I find tin to be best for these small fans. This is the handiest size that I know of. Fan 6 in. diameter, pipe 14 in. long. $2\frac{1}{2}$ in. square at fan, and $1\frac{1}{4}$ in. at end. Driving wheel 7 in. diameter fully on spindle, $\frac{3}{4}$ in. groove. If you have followed WORK up in soldering, and other things, BELLOWS should be able to make this."

Colouring Photographs.—S. H. C. (*Penzance*) writes in reply to EXPECTANT (see page 174):—"EXPECTANT finds difficulty of making water colour stick on the photo. If he would lick the photo over before painting, the saliva would render the surface fit to hold colour. There are preparations sold to work with, but I find the spittle best and handiest, if I may so apply the word. Gum arabic and water is a medium."

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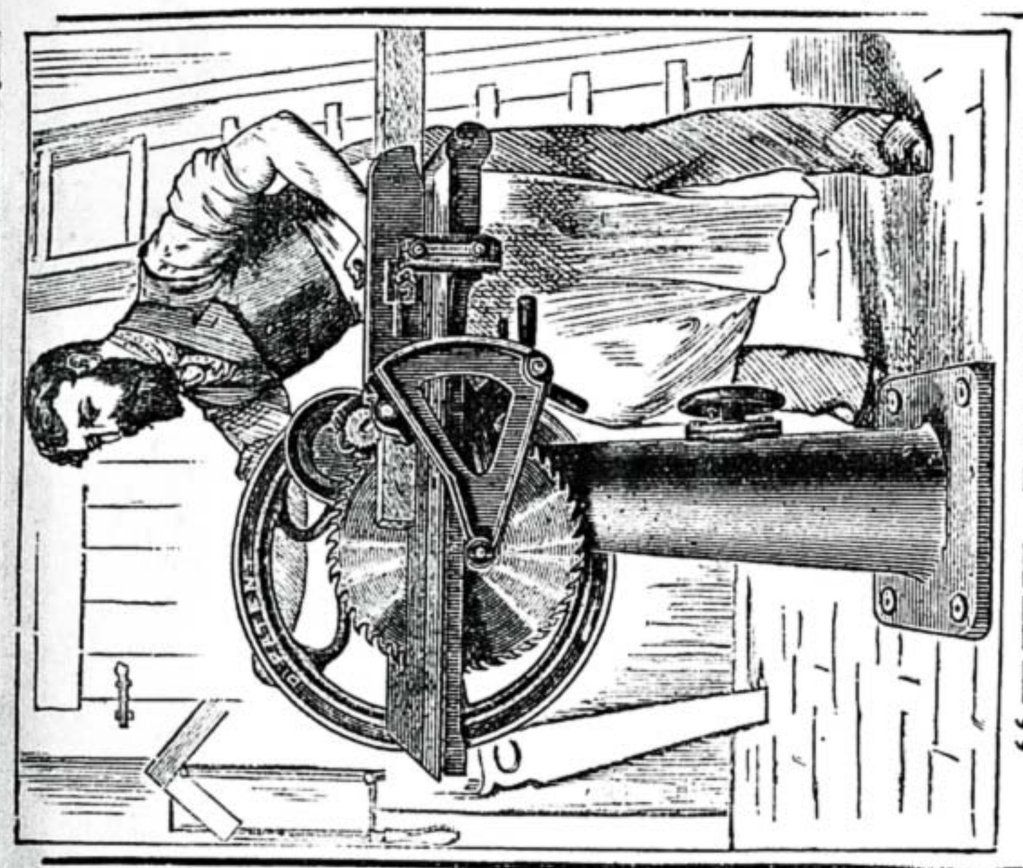

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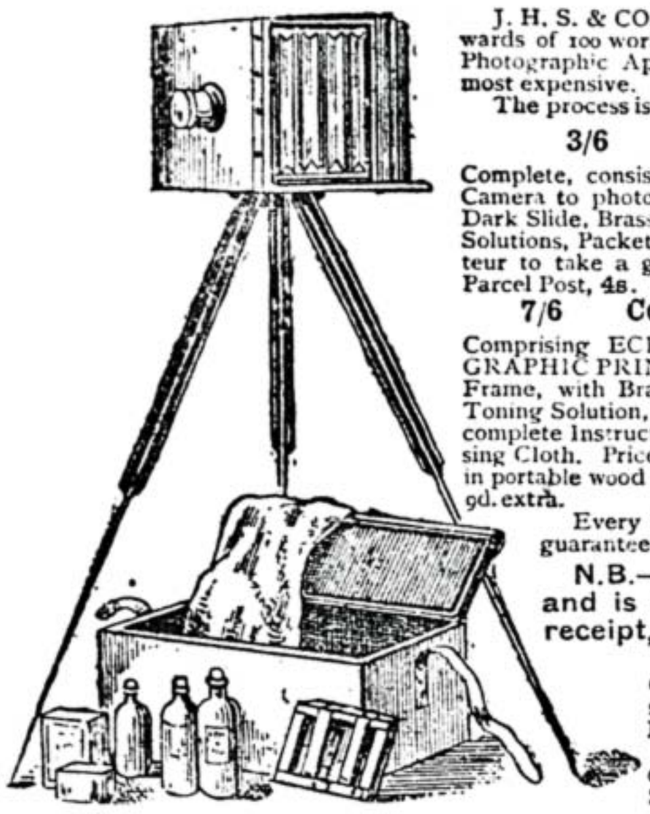

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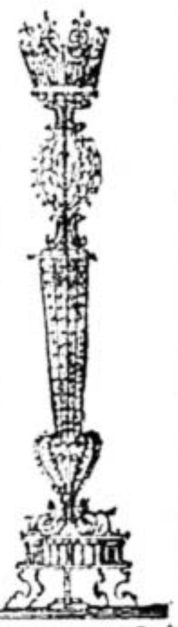

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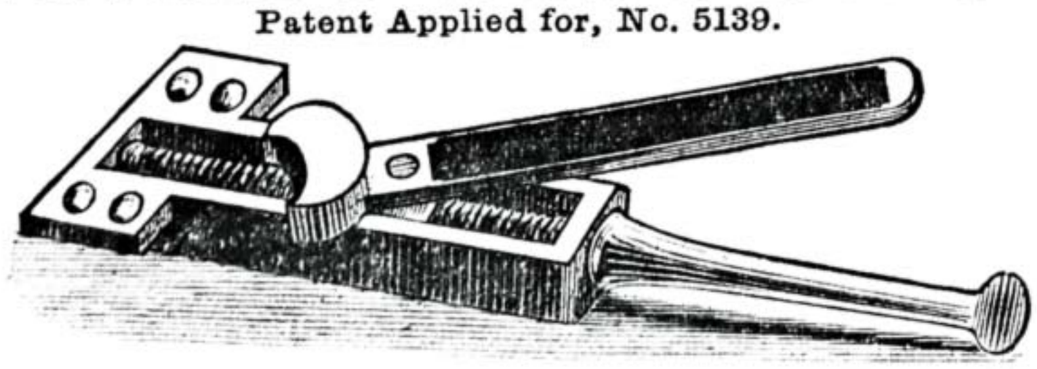

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